THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 58 Thursday, January 13, 1938 No. 1117

The Editor's Review of the Foundry Industry in 1937

BY 1935 the foundry industry of the world had emerged from slump conditions, and except in the countries which were adhering to the gold bloc, was in a healthy condition. South Africa, though by no means a great industrial country, was from the foundry angle probably the most prosperous, and France was possibly the country in which business was at its lowest ebb. The following year, especially after France had departed from the gold standard, was one of straight-line progress. Shortage of certain raw materials was unquestionably being felt by the totalitarian countries, but this was related to currency restrictions.

Last year, with the solitary exception of America, conditions were characterised by excessive pressure on the production resources of the foundry industry of the world for roughly the first six months, associated with something of a scramble for raw materials. Then, perhaps fortuitously, the Wall Street market broke, and repercussions were felt throughout the world. The main effect was salutary, as it only resulted in lowering the price of industrial shares, and some of the non-ferrous metals. It made people take a saner view of the general conduct of business, and reduced "hogging." Mr. Oliver Smalley gives a brilliant analysis of the situation in America, and differentiates between the 1937-8 conditions and those existing in 1929. Fundamentally, the conditions are entirely different, and a change in the political diet would probably effect a rapid amelioration of industrial conditions.

A factor in international trading conditions which is insufficiently appreciated in this country is the reciprocal trading agreement between a number of the smaller countries of Europe. It was initiated by Belgium, and includes *inter alia* the Scandinavian countries. Its operation is sufficient to prevent the development of certain foundry products in some countries and also to injure British exports.

The national self-sufficiency campaigns in vogue in many countries must be studied by British industrialists. Primarily, without an appreciation of such conditions, much of the published research work is unintelligible, but what is more important is the possibility that intensive study in fields not of major immediate interest to United Kingdom manufacturers may very well lead to results of an epoch-making character. Dr. Geilenkirchen, for example, refers to the work now being done in Germany to reduce waste resulting from the extravagant use of runners and risers, and in this very useful sphere pointers have been given by Deschamps in connection with steel castings. This type of study is, to our mind, but a by-product of the general thought directed to the elimination of imports of expensive raw materials, and is obviously significant. Dr. Guido Vanzetti, too, points to the great effort Italy is making along similar lines, whilst in this country serious endeavours are being made to make every area, if not a contributor to, at least not a consumer of national wealth. We refer, of course, to the resuscitation of the depressed areas.

Coming now to the particular conditions existing in the foundry industry of the United Kingdom, the forecast which we gave last year at this time was so accurate that, if we but altered the tense from the future to the past, it would be definitely correct. The majority of the plants *have been* worked to capacity, there *has* been a shortage of both raw materials and highly-skilled labour. A survey we have made reveals that 48 per cent. of the foundries of the United Kingdom have increased their personnel; 44 per cent. carry the same labour force as during 1936, and in 8 per cent. a reduction has taken place. Obviously, the incidence of reduction in a period of boom requires investigation; in the majority of cases it is related to mechanisation, and our surveys have indicated to us that this usually means either a temporary phase or transfers to other departments. In general, over a period of years, firms mechanising increasingly employ more labour year by year. About 85 per cent. of the foundries report a shortage of labour, especially of the highly skilled type.

The extensions to shops and plant have been of a serious character, but we doubt if they have exceeded the economic capacity of the country. As Mr. Harper points out—and he uses the fact as a warning—several hundred foundries disappeared during the slump. Since that time new industries have come into being which absorb vast quantities of castings. We use our influence wherever possible to prevent new engineering firms creating foundry departments, as their existence is provocative of price-cutting during periods of depression.

CONTENTS

	Page
The Editor's Review of the Foundry Industry in 1937	23
Trade Conditions in the Grey Iron Foundry Industry	25
The Steel Foundry Industry	26
The Malleable Castings Industry	27
The Institute of Vitreous Enamellers and the Enamelling Industry	28
Work of the Institute of British Foundrymen	29
The Pig-Iron Industry	30
Foundry Mechanisation	31
Recent Developments in Non-Ferrous Foundry Practice	33
Marine Engineering Foundrywork	35
The Die Casting Industry	37
The Refractories Industry	38
The Foundry Equipment and Supplies Trade	39
The Motor-Vehicle Foundry Industry	40
The Non-Ferrous Metal Markets in 1937	41
Dates and Data	42
The Future of the British Cast-Iron Research Association	43
The Light Castings Industry	46
The Foundry Industry Month by Month	47
The Foundry Scrap Trade	48
Expansion in the Iron and Steel Industry	48
Research and Development Work in the Field of Non-Ferrous Metals—	
Aluminium in the Foundry	49
Copper Developments in the Foundry	50
Lead in Foundry Practice	52
Nickel in Ferrous and Non-Ferrous Foundry Practice	53
The Tin Industry	56
The American Foundry Industry	58
Recent Developments in the French Foundry Industry	59
The German Foundry Industry	61
The Czecho-Slovakian Foundry Industry in 1937	63
The Polish Foundry Industry and the 1938 International Foundry Congress	65
The Russian Foundry Industry	67
The Italian Foundry Industry	70
The South African Foundry Industry	72
The Belgian Foundry Industry	74
This Week's News in Brief	76
Trade Talk	76
Company Meeting	76
Personal	76
Obituary	76
Contracts Open	76
New Companies	76
Forthcoming Events	76
Raw Material Markets	78

Light Castings Industry

The available statistics show that the value of the exports of stoves, grates and the like rose for the first eleven months of 1937 to £536,981, as compared with £486,244, but the quantity was reduced to 44,414 tons as against 48,471 tons in 1936. This means that the average export selling price was increased by over £2 10s. per ton. Good trade is also recorded for sanitary cisterns, where the volume of business rose, again for eleven months, from £85,377 to £113,077 and had reference to 7,786 and 11,584 tons respectively, which means there was a decrease of over a pound in the selling price. Hollow-ware, which no doubt includes castings, has been sold in lesser quantity, but at a higher price. Imports of stoves, grates, and the like are again tending to increase, and the value last year (eleven months) rose from £68,450—the 1936 figure—to £81,059. A similar condition exists in the bath trade, where again imports have risen from £182,466 to £196,774 for a similar period, and for these an extra £5 a ton or so was paid. The importation of hollow-ware, too, is gaining ground rapidly; an advance of something of the order of 15 to 20 per cent. has been registered. This situation obviously requires careful scrutiny by those interested in this manufacture.

Some of the "dismal Jimmys" who control the editorial policy of the lesser responsible daily Press have magnified the normal seasonal falling-off in trade in this section of the industry as heralding a slump of the first magnitude. Actually this falling-off was less in its incidence than is experienced in a normal year. The employers' federations controlling the destiny of this section of the foundry industry rank amongst the most enlightened. They have initiated a competition for a slogan for cast iron as a prelude to an advertising campaign of a more serious character. We congratulate them on their enterprise and wish them every success. A new foundry to replace one closed down because of the inadequacy of the site has been opened up at Warrington, and is now in full production.

The bath section has been working to capacity, and one Scottish foundry has just opened a new showroom attached to their premises. Another foundry maintains its production at the level of two thousand baths per week.

A few foundries engaged in the cooker trade, in common with a few others making articles destined for the kitchen, have not been too busy. This situation may be due to rumours of wars having the effect of tightening the housewives' purse strings. It has obviously not yet affected the male species, as the Christmas bank-note circulation was of a record character. Despite this situation, one very large firm has completely mechanised its foundry, whilst a second has installed a continuous moulding plant, a new press shop and assembly room. Propaganda to replace the cast cooker by pressings is abating, as experience of the latter in use has not been too favourable.

The prospects for the foundries catering for the building industries are reasonably good, as the normal slum clearance schemes are to be reinforced by railway station modification, led by the reconstruction of Euston. Judging by com-

parison with the tonnage consumed by a large modern hotel or block of offices, the amount of rain water goods and soil pipes to deal with such a vast area as Euston Station, plus an hotel and offices, will require several thousands of tons of cast iron goods. Moreover, requirements for the upkeep of the new housing schemes are already a factor in the market

Pipe Foundries

We believe that British pipe foundries are technically more efficient and certainly as well equipped as any in the world, and they indeed deserve the increased trade they have enjoyed in the export market. During the first eleven months, they have increased their exports to just over the 100,000 ton level, representing an increase of 11,000 tons. Moreover, this business has been effected at a higher average selling price of about 16s. per ton. Imports of cast-iron pipe are lumped in with fittings, which refer in the main to malleable fittings, as the import price borders on the £40 level. A slight decrease in value associated with a materially higher tonnage is significant.

Last year the industry, which can only be very slightly influenced by the rearmament programme, enjoyed a period of steady progress. A duplicate of the existing mechanised "specials" foundry has been installed, and the spinning plants continue to be augmented, either to extend existing facilities or cater for new sections.

Motor-Vehicle Castings

Both attached and detached foundries making motor-vehicle castings continue to modernise and mechanise. These foundries lead the industry both from the mechanical and metallurgical viewpoints. A further example of the use of the electric furnace for melting and duplexing cast iron is furnished by a foundry catering for the heavier type of motor vehicle. The production of cast crankshafts and camshafts is rapidly expanding as confidence in the new material increases. British motor-cars are gradually strengthening their hold on the export market, particularly for city use in the great Dominions. British foundry machinery is at long last finding increasing favour with the motor-car manufacturers, who for the last decade tended, because of accumulated experience, to buy from America.

Electrical Engineering

This progressive industry has been well occupied during 1937. The consumption of electricity is continuously growing, every year producing record figures. With its latest extensions Barking Power Station will be the largest in Europe. We believe this is interlocked in some way or other with the Ford concern, which now has on order a second 30,000-kw. turbo-alternator. Some interesting export orders for turbo-generators have been received for delivery to Detroit, Hong Kong, Kuala Lumpur, Bulawayo, Johannesburg and Australia. Another interesting contract was for a 720-ton moving platform for converting the floor of the Earl's Court Exhibition swimming pool into a raised platform. The foundry industry now possesses at least five mechanised plants for making the lighter castings used for electrical applications. A new one has only recently been put into operation and will be engaged mainly in fuse boxes.

Jobbing and Attached Foundries

The small country jobbing foundries have had a much better time in 1937. Some operate entirely on scrap which they have means of procuring without resorting to the open market. There is, obviously, always a shortage of skilled men in the country districts, especially since the labour exchange system virtually put an end to journeymen going on tramp. Many of the largest foundries consider that they enter into the jobbing trade as they receive but little quantity-off work. One of the largest of this type has installed an oil-fired rotary furnace of the highest capacity—5 tons—so far made. Its progress will be followed with considerable interest by the industry.

The "attached" foundries, such as those forming departments of the machine-tool trade, have been exceedingly busy during the year. A number of extensions are reported, and endless ingenuity has been exercised to attain increased tonnages from existing floor space. It is always a matter of amazement to us how absolute chaos is avoided in these large foundries, where each area demands varying lengths of time for the production of a mould. Yet each week, virtually the same quantity of metal is poured. One foundry we have in mind should have the position alleviated as it has provided itself with an additional foundry capable of making castings up to 60 tons weight. Most railway foundries, except those engaged on chairs, are "attached," and it is pleasing to note that some of the money which the Government lent to the companies during the slump period for carrying out urgent works has found its way into the foundries, which are now reaping the benefit.

Iron and Steel Works Foundries

These can be classified amongst the busiest of all, as last year there was a record production of steel of 12,900,000 tons, which eclipses the 1929 boom year by over three million tons. Certain of these foundries are not particularly up to date, and whilst the "going is good" we suggest that the time is opportune to modernise them. In the roll foundries, intense pressure has been experienced, in spite of the increasing use of steel rolls. Distinct metallurgical advances are being made in these foundries, but they rightly refuse to make radical changes, preferring to "make haste slowly," consolidating their position step by step.

Shipbuilding

Definite progress has been made in the large marine engineering foundries, though many would like to see a better proportion maintained between mercantile and naval work. At the moment, there is too little of the former. Mr. Gresty comments on the importance of cast-iron propellers, probably having in mind the publicity which the manganese-bronze variety receives. Because cast-iron propellers above a certain critical speed suffer from cavitation, the largest and fastest boats, which are naturally of great news value to the Press, install manganese-brass blades, which share in the general publicity.

Agricultural Implements

Whether this section of the industry will ever attain its pre-war importance is doubtful, but one thing is certain, and that is that one of the foundries catering for the dairy side has achieved such a world-wide business that its position is extremely well established. Last year this firm was busy erecting a completely mechanised foundry which is just ready for putting into production. The other agricultural-implement foundries have been extremely busy, but, with few exceptions, no longer do they put all their eggs into one basket; most of them now include other lines of activity. The days when huge consignments of agricultural machines left East Anglia for Russia and parts of the old Austro-Hungarian empire have gone, never to return. The industry after much pruning is now on a thoroughly sound footing, and is certainly capable of reasonable expansion by the exercise of initiative.

Textile Engineering

There has been about a 10 per cent. expansion in this industry. During the last decade many foundries went out of business, leaving those still in harness in a fairly strong position. There is still room for much technical improvement, taken as a whole, and progress in this direction has been made by the part rather than by the whole. As a metallurgist we insist that resort to annealing of grey iron castings should not be necessary, and a study of modern motor-car foundry practice should provide the solution. We are aware that the very modern Black Country repetition foundries also resort to annealing, but to a much less extent. For the future the outcome of the Sino-Japanese war may have a profound effect upon the textile industries. It is just as likely to impair as to ameliorate the position of Japanese export trade.

Malleable Castings

During the last few years a good deal of modernisation has permeated the malleable iron foundries, and most of the better-equipped ones were in a good position to handle the increased business available last year. They have carefully studied both melting and annealing procedure, and produced material showing improved mechanical properties, but so far, with the exception of one foundry attached to a motor-vehicle organisation, they have fought shy of the quick-anneal process. Maybe, now that more data have been made available concerning the addition of copper to malleable cast iron, the process may find increased popularity. Several of the most important foundries have extensions of a major character in hand, but in more than one case delays have been experienced owing to a shortage of constructional steel work.

Steel Foundries

The extraordinary activity noted in our review last year has continued unabated throughout the year. Some new foundries, one in South Wales, have been put into operation, whilst most of the others either have undertaken or are carrying out a thorough re-equipping. These plant extensions are being very intelligently thought out, for it is only too easy to make expensive mistakes in this section of the industry. On the one hand, not all the equipment successful in iron-foundry practice is invariably suited to steel foundry practice, whilst steelworks plant often possesses similar drawbacks. To attain the maximum of success in this particular field of activity, there must be the creation of a staff of highly skilled moulders which will *co-operate enthusiastically* with a management possessing more practical knowledge than the operatives plus a sound insight into the more theoretical technology. We have italicised two words, because the existence of the balance can be taken for granted. The acquisition of this practical knowledge is, of course, gained by the keeping of records, compiled only with difficulty by the operative. The building up of such conditions will serve firms better in periods of depression than large cash reserves. An interesting development has been the commercial success of a large-scale pulverised-fuel-fired rotary furnace for the production of metal for steel castings.

Non-Ferrous Foundries

Labour shortage has been particularly pronounced in this section of the industry, and London foundry managers have visited Birmingham with the object of securing extra moulders, only to find the shortage there even more pronounced. Several noteworthy extensions have been carried out, especially by those firms making light-alloy castings. The vagaries of the metal market have not reflected in the slightest degree the activity of the foundry industry, one of its largest consuming units, but rather have they mirrored the Wall Street stock market. The alloys which have been developed by the United Kingdom aluminium foundry industry have received international approbation for soundness, strength and reliability, and licences for their manufacture are eagerly sought by overseas foundries. Die-casting continues to make progress, although the producers unfailingly grumble because orders of even gargantuan dimensions never are sufficiently large for their apparently inexhaustible output capacities. Nevertheless, they seem to prosper mightily on odd little orders for a mere 5,000-off. Gradually they are entering the engineering field with stronger alloys, utilising mixtures of higher melting points. The future for die-castings is indeed a bright one.

Trade Conditions in the Grey Iron Foundry Industry

By WILFRID H. HARPER (Director, John Harper & Company, Limited)

THE last time the writer was entrusted with the task of reviewing trade conditions in the grey iron foundry industry was in 1934. Since that date much has happened. Slowly but surely the industry emerged from the depths of the 1931-1932 depression, each year showing a genuine improvement in practically all trading outlets for grey iron castings.

Then in 1936, on top of all this natural return to prosperity, circumstances over which industry had no control forced the country to embark on an immense rearmament programme, in order to bring the defence requirements up to safety. This unforeseen influx of orders upset many calculations and soon brought about an acute shortage of both raw material and skilled labour, thus creating an unnatural trade boom, which reached its peak in the late summer of the year under review.

Whilst 1937 will certainly go down as a year of almost unparalleled activity, full order-books and increased selling prices, it will also be remembered as a year of intense difficulty in obtaining pig-iron, coke and raw materials, coupled with an absolute shortage of skilled moulders.

The difficulties attendant on securing regular supplies of raw materials are now certainly becoming less troublesome. The recent announcement that present prices of steel will be stabilised until the end of 1938 is perhaps rather significant.

The title, "Trade Conditions in the Grey Iron Foundry Industry," covers a wide field of activities, from the typical Midland backyard foundry up to the large highly-mechanised specialist foundries engaged in making castings for the building, gas-stove, electrical fuse-box and motor vehicle trades.

"A Sellers' Market"

During the greater part of the year, owing to the demand for castings exceeding the supply, a sellers' market existed, and the buyer who worked on "hand-to-mouth" supplies found himself in serious difficulties. This shortage caused some new foundries to be built and many existing plants to be extended. A word of warning might be added at this stage, when one remembers that between 1927 and 1933 over 500 foundries went out of business largely owing to ignorance of costing, and consequent panic cutting of prices. It is exactly the same type of mentality which during boom conditions charges excessive prices. It is the organisations which can keep level heads during boom time conditions, and do not take advantage of a sellers' market, which find when conditions change that their policy of moderation is amply rewarded.

Design

To most people "design" in cast iron conveys visions of over-elaborate ornamentation, of scrolls, fleurs-de-lis, rosettes, etc., which flourished during the Victorian era on such articles as gas fires, oil lamps, and so on. It is most interesting and gratifying to see that some of the largest manufacturers of cast-iron stoves and hardware have now put on the market articles which have been designed not from the over-elaborate traditional angle, but from the strictly functional angle, resulting in really pleasing finished products.

One is glad to be able to report that an increasing number of foundries are, year by year, becoming more "welfare conscious." More and more thought and time is being devoted to lighting, heating and ventilation. Also, holidays with pay are becoming more general. It is perhaps significant that during the extremely busy periods through which industry has been passing, some of the people who have complained most bitterly about labour shortage are those who give little or no attention to matters regarding welfare.

High Duty Irons

Although the rearmament programme has undoubtedly congested the grey iron industry, it has had a far greater effect, in this direction, on the steel foundries, whose delivery dates go many months ahead. This has caused many users of steel castings to consider the substitution of high-duty alloy cast iron, owing to the fact that more reasonable delivery could be given; consequently high-duty cast irons are being successfully used to an increasing extent.

One of the special high-duty irons now well established as a reliable engineering material is

MR. WILFRID H. HARPER.

"Meehanite" metal. This is an outstanding material in so far as it is consistent, its high physical properties are uniform in all sections, and it is uniformly machinable. During the past year the demand for this material has shown continued marked progress in its application to both exacting engineering conditions and to special industrial applications. The number of licensees has increased considerably in the United States, on the Continent and in this country, and the process has also been established in Australia and South Africa.

It is now generally known that this cupola product is cast into camshafts and crankshafts, of which large numbers are in service in both motor cars and heavy commercial vehicles. One outstanding feature of considerable interest, particularly on the Continent, has been the substitution of cast, forged and alloy steel and also bronzes by the new alloyed Meehanites. It has also found wide application for diesel engine liners, pump bodies, liners and crankshafts, large valves subject to river and sea water corrosion and in chemical plants. Other applications of interest are dies for glass and Bakelite and cast-to-form dies for deep-draw metal work, as well as non-growing and non-distorting castings for high temperature furnace applications.

The demand for this material by the machine-tool industry during the past year has assumed large proportions. This, no doubt, is accounted for due to its combined high physical properties and excellent damping qualities, ensuring high resistance to fatigue failure, together with its almost perfect machinability. For some years a Meehanite Research Institute has been very active in the United States, and a similar Research Institute was started in this country about two years ago. These scientific and technical bodies work conjointly and are constantly improving Meehanite products and developing new materials to meet the ever-increasing demands of progressive industry.

A Protected Industry

It should not be forgotten that the foundry trade generally continues to benefit from conditions arising out of the fiscal change of policy which the National Government brought about. Such industries as the motor-vehicle, office equipment and agricultural implement have all been given an opportunity of building up behind a protective wall, which they have used to full advantage, and improved their quality, increased their output, and reduced their selling prices. These facts should be remembered during the trade agreement conversations which are to take place in 1938 between this country and the United States.

There have been no remarkable developments during 1937, but continued progress has been made by the Randupson process of using cement-bonded silica sand blocks for the manufacture of large castings.

Core-blowing machines are now well beyond the novelty stage, and very intricate cores are being successfully made, resulting in large economies.

Progress has also been made in the use of patternmaking by compounds, though Continental foundries have developed this method of patternmaking to a far greater extent than foundrymen have in this country. Airless shot-blast equipment continues to replace the pneumatic method of cleaning castings.

Reaction to Non-Foundry Competition

Owing to competition from Bakelite mouldings, die-castings and metal pressings, customers continue to tighten up their inspection of grey iron castings, and are demanding, and getting, a finish with a degree of accuracy which but a few years ago would not have been considered possible. This all makes the foundryman look more closely into his sand equipment, patterns and finishing departments.

Despite the continued reassuring statements from those in high places, there is undoubtedly a feeling of anxiety afield. Many foundries reported conditions at the close of the year to be less healthy than they were at the corresponding time in 1936. This seems to apply especially to those plants producing castings for the building, gas cooker, and motor-vehicle trades.

On the other hand, conditions are more sane than they were last summer, when panic buying became very noticeable. Should there be a serious fall-off in 1938, this will, to a certain extent, be counter-balanced by the re-armament programme which during 1938 will obviously find work for an increasing number of foundries. Also, it should be borne in mind that a great deal of re-equipment for such industries as the railways is being postponed, together with slum clearance, and public works schemes, etc. All these will be waiting to take the place of re-armament orders. Nevertheless unemployment returns for the last two months have been rather disquieting. It will take all the energy and time of the grey iron foundry industry to produce as high a tonnage in 1938 as it did during the year 1937.

The Steel Foundry Industry

By G. ERNEST WELLS (Director, Kryn & Lahy, Limited)

ONCE upon a time the Editor of THE FOUNDRY TRADE JOURNAL, using those powers by which he is so well known, persuaded me to write an article on the Steel Foundry Industry. That was in 1930, and now, with his tongue in his cheek, he sends me a copy

MR. G. ERNEST WELLS.

of what I then said, with a request for my views on things as they seem at present.

In 1930, it will be remembered, output was about 50 per cent. of capacity, and before long the figure had dwindled to 25 per cent. I felt that a reduction in capacity was essential and, to judge by the efforts which were made to bring it about, I was in good company. Many meetings were held, experts on reorganisation were consulted, schemes were produced galore, but nothing concrete was accomplished in the desired direction.

On the other hand, there can be no doubt that the many conferences and discussions which took place were of immense advantage to the steel casting industry. Makers were brought together in the presence of business men who had no interest except in the trade as a whole. Essential figures were furnished in the knowledge that they would be put together and analysed by professional accountants, who would not divulge details of one maker's affairs to another, and in this way it was found possible to assess the state of the industry.

General Steel Castings Association

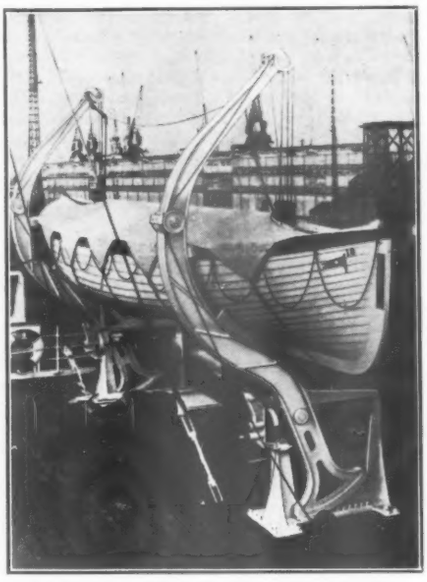
At this stage it was realised that whilst the proposal to reduce capacity presented difficulties which were well nigh insuperable, something must be done to avert disaster. Accordingly, the General Steel Castings Association was formed, and every maker of steel castings was invited to become a member.

Since its inception steady progress has been made, although many difficulties have had to be overcome. The steel founder is essentially individualistic, and I sympathise with the man who has to preside over a meeting of them. Nevertheless, it has been found possible to reconcile strongly differing viewpoints in the general interest, and the fact that differences do exist is the buyer's greatest safeguard. In other words, the minimum prices are fixed not on the basis of the highest cost figures submitted, but rather of the lowest, thus stimulating efficiency and forcing every founder who wants the business to put his house in order.

In point of fact, I believe that with the present activity in the trade, prices would have risen much higher but for the work of the Association. Certainly the decision to follow the policy of the British Iron and Steel Federation, as far as possible to stabilise prices in 1938, notwithstanding the increased costs arising from the higher price of hematite and other causes, would not have been made by individual founders working independently.

How far the bringing together of men whose main idea for years had been to cut one another's throats was due to common adversity, and to what extent the present co-operation is due to "better times," no one may say with certainty. It is to be hoped, however, that if and when there is a slackening off in the trade, wise counsels will prevail.

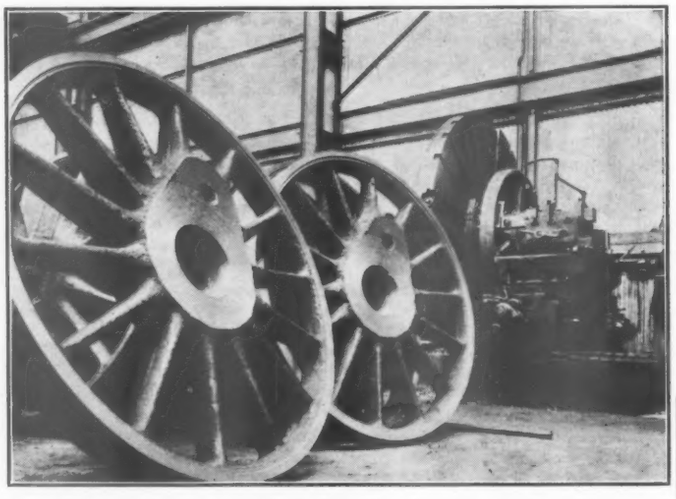
At the time of writing every steel founder has all the work he can handle, and each is now as fully occupied trying to satisfy his customers as he was a few years since trying to get work. I hope the steel founders will continue to experience the prosperity which, as one of them, I feel they so richly deserve, and if I may conclude by making a suggestion, it is this—*let them concentrate on the production of a standard costing system which can be used by all.* When this is accomplished (and it is no light task), their meetings will take up less valuable time and the business will run more smoothly.



SHIPS' DAVITS, CAST IN K.L. "STRONGER STEEL," IN POSITION ON DECK.

A CAST-STEEL FLASK JOLTER CYLINDER WEIGHING 6½ TONS.

[Photos. courtesy of Kryn & Lahy, Limited.



CAST-STEEL LOCOMOTIVE DRIVING WHEEL CENTRES FOR THE GREAT WESTERN RAILWAY.

The Malleable Castings Industry

By G. R. SHOTTON (Works Manager, Shotton Brothers, Limited)

THE year 1937 has been a year of mixed blessings, in that raw material supplies and the dearth of skilled labour have imposed a limitation on the extent to which the industry could take advantage of the boom conditions which have prevailed.

In other respects, however, the year has been the most cheerful for many years past. The general level of trade has probably been higher than that of any year since the war, and the great majority of malleable foundries have been working to full capacity throughout the year. In very many cases, foundries have been unable to accept all the work offered to them, and considerable extensions to plant have been made, or are being made, to cope with this extra demand.

This increased demand is all the more satisfying because there are many indications of a wider application of malleable cast iron in the engineering and other trades. There is, therefore, every reason to expect that the increased capacity of the industry can be fully exploited in the future, even in the event of some slackening in the engineering industry generally.

Progress in Quality

The very noticeable improvement in the quality of malleable castings, which has been so apparent during recent years, has been fully maintained during 1937. A rigid metallurgical control and a sound foundry technique are to be found in an increasing number of foundries, and the proportion of really first-class malleable produced is rising very rapidly. An engineer who uses reasonable discrimination need now experience no qualms when specifying malleable cast iron for intricate and vital components.

Both blackheart and whiteheart types of malleable have, in their own particular spheres of application, shown a very marked improvement in quality. With the extended application of improved melting methods, such as the rotary furnace, whiteheart malleable irons of a consistently higher quality are now being produced. In fact, the time is approaching when two distinct types of whiteheart will be recognised, *i.e.*, the wholly decarbonised type, which gives such excellent service in thin-walled castings such as cycle fittings, and the partly graphitised type, produced from low total-carbon irons, for medium-section castings.

This development, allied with the very high quality of blackheart malleable now produced by a number of foundries, would appear to indicate an early revision of the principal standard specifications operative in this country.

The Technical Committee of the Institute of British Foundrymen is carrying out a considerable amount of work in this connection. Their efforts in respect to cast iron have been brought to a successful conclusion, and a series of new B.S.I. specifications covering high-duty cast irons, largely based on their recommendations, is now in use. The Technical Committee, through the Malleable Iron Sub-Committee, is now carrying out exhaustive investigations with a view to putting forward recommendations for the revision of the B.S.I. specifications for malleable cast iron.

An increase in the elongation requirements in the revised specifications would appear to be fairly certain, certainly in the case of blackheart malleable iron. At the same time, it is to be borne in mind that there is a very definite field of application for the lower grades of malleable iron, and the committee is considering the practicability of incorporating two grades in the new specifications. There are many arguments for and against this course of action, and it seems probable that help from the trade will be sought by circulating a questionnaire on this subject. It is to be hoped that as many foundries as possible will collaborate by fully expressing their views in their reply to the questionnaire, which it is hoped to circulate in the early part of 1938.

Improvement is also to be noticed in what might be termed foundry technique. Engineers to-day are demanding dimensional accuracy of a degree which certainly could not have been attained a few years ago. Machining allowances are cut to a minimum, and in many cases machining operations have even been eliminated altogether. This has been made possible only by close collaboration between the foundry and the drawing office, and an increasingly large

MR. G. R. SHOTTON.

number of consumers are to be congratulated on the willingness they have shown in considering, and even in inviting, suggestions from the foundry.

Raw Materials

The difficulty of obtaining adequate supplies of raw materials has been the biggest stumbling block to expansion of output. Hematite pig-iron, in particular, has been a source of worry to the malleable ironfounder, since the exceptional demand from the acid steel smelters has resulted in a definite restriction on supplies for the foundry. Very few foundries have been successful in maintaining reasonable stocks, and delays in delivery of pig-iron have sometimes had serious results.

The successive increases in the cost of hematite pig-iron have also had serious repercussions on the malleable ironfounder, due to the time lag imposed by heavily loaded order-books and negligible stocks of pig-iron.

Coal and coke have also been subject to several increases in cost, though supplies have come through with less delay than has been the case with pig-iron.

Successive increases in raw material prices, together with rising labour costs, have made necessary a more or less continuous raising of selling prices throughout the year. On the whole, consumers of malleable castings have shown a sympathetic attitude, but there are signs that their patience is giving out due to the frequency with which increases have been made necessary. With the stabilisation of pig-iron prices for the whole of 1938, however, it is to be hoped that foundry costs and selling prices will now show more stability.

Malleable founders, perhaps more so than grey-iron founders, have experienced a dearth of skilled and semi-skilled labour. Batch-type melting furnaces, as opposed to the cupola, render mechanisation a more difficult matter than is the case in grey-iron foundries. It is the general experience in malleable foundries that even those moulders engaged on repetition work develop a technique comparable with that of the skilled floor moulder.

Boys leaving school show considerable reluctance to enter the foundry, and it would appear that far too low a proportion of "trainees" or apprentices are employed. Unless the foundry industry is to experience a serious shortage of skilled labour in the course of a decade or so, some form of publicity would appear necessary to attract boys for training.

Technical Progress

Although literature on the subject of malleable cast iron is remarkably scanty, there is no doubt that very marked technical development is taking place. The rotary furnace has opened the way to considerable development of certain types of whiteheart malleable iron, by providing a medium for the melting of irons lower in total carbon. The larger capacity and flexibility of the air furnace and open-hearth furnace, however, have justified their continuance as a melting medium for blackheart malleable, though the rotary furnace is also being adopted, mainly at the expense of the cupola.

Annealing ovens have also been vastly improved during the past year or so. The use of pulverised fuel as a firing medium maintains its popularity, and a noticeable improvement in the design of gas-fired ovens has led to a considerable increase in the number of such installations.

Short-anneal malleable continues to attract experiment, but so far to the author's knowledge it has not been successfully applied to commercial production in this country. The highly critical nature of this annealing cycle is bound to result in some inconsistency of quality, except in those foundries which are fortunate enough to be engaged on bulk production of a particular type of casting. Much of the success of short-anneal malleable in the United States can be attributed to this factor, together with the comparative cheapness of electricity in that country, which makes possible the commercial exploitation of the electric annealing furnace.

Prospects for 1938

There is a general spirit of optimism prevalent in the malleable industry. The use of malleable cast iron is definitely gaining ground in this country, and the United States continues to hold out an example of what can be attained in the future.

As far back as 1931 the U.S.A. Department of Commerce estimated the American output of malleable castings at 1,350,000 tons per annum, whereas our own Board of Trade issued Census figures for 1935 showing the British production at only 53,600 tons. There is every reason to hope, therefore, that the continually widening field of application for malleable cast iron, together with its rapid improvement in quality, will enable this country, in the very near future, to show production figures more comparable with those of the United States.

(*Concluded on page* 28.)

E

The Institute of Vitreous Enamellers and the Enamelling Industry

By W. H. WHITTLE (Chairman of the Institute of Vitreous Enamellers)

LAST year, owing to continued ill-health, Dr. J. W. Mellor, F.R.S., found it necessary to resign most of his activities, including that of the presidency of the Institute of Vitreous Enamellers. He was elected to that office at the inception of the Institute in 1934, and presided over its destinies until last October. During those three and a half years he gave much time and thought to the various problems, and willingly placed his vast knowledge and experience at the service of the members. A very deep debt of gratitude is owing to Dr. Mellor, and once again, on behalf of the Institute, grateful thanks are accorded to him for his great service. With this is associated deep sympathy with Dr. and Mrs. Mellor on account of his illness. Members of the Institute will be gratified that the King has recognised his scientific attainments and generous help to industry by bestowing upon him the Commandership of the British Empire.

The new President for 1937-38 is Sir Harold Hartley, C.B.E., F.R.S., M.C., M.A., and in this choice the Institute is indeed fortunate, as his distinguished record in such diverse fields of activity as physical chemistry, research, chemical warfare and now railway direction makes him one of the most sought-after leaders of scientific thought in the land. At the 4th annual meeting of the Institute, held in Birmingham from October 8 to 10, he showed in many ways that his great experience is bound to be of the utmost help to the Institute. His public spirit in coming forward certainly warrants the fullest support of the whole of the industry.

Though excellent progress is being made, there is still much to be accomplished, but this takes time. The annual conference was unquestionably a real success viewed from no matter what angle. The Papers presented created great interest, the one dealing with the historical development of the industry, by Mr. W. E. Burton, and the other a monumental work by Dr. Stuckert on tin oxide as an opacifier. The writer wishes to avail himself of this opportunity to thank the Lord Mayor and the municipal authorities of Birmingham and the local committee responsible for the organisation of the Conference.

Membership is showing a steady increase, and the Council appreciates the whole-hearted support given by most of the largest firms in the industry, although they regret that a few have not yet seen fit to lend their support.

The Trade Sign

This last year saw the granting of the sign, and for its industrial use the Council has made available supplies of transfers, labels and book-

MR. W. H. WHITTLE.

lets, and is hoping that this year will see the general adoption of the sign by the trade. The main object is to proclaim to the general public two facts:—(1) That the material carrying the sign is genuine vitreous enamel and not the "stoved" variety; and (2) that it is of British manufacture.

Education and Research

It has been repeatedly stated that it is becoming increasingly difficult to obtain skilled executives to take charge of the various operations practised in the vitreous enamelling industry. This condition is bound to continue for some years, as the extension of existing plants and the creation of new works have outstripped the supply of skilled technicians. This condition would be the more quickly ameliorated if the whole of the trade gave their fullest support to the Institute, because the extra income so obtained would reinforce the necessarily small funds now available for research work. It is the existence of published technological work which primarily attracts the young scientist to any industry. Secrecy in the conduct of technical processes usually invites the attention of the charlatan. It is well known that offers of recipes contained in grubby note books have been hawked around the industry and consistently refused by reputable manufacturers who are, of course, averse to buying a pig in a poke, especially as the "pig" is invariably of doubtful ancestry.

The activity of the Institute can be judged by the fact that, during the last session, twenty-four technical meetings were held by the four sections and were invariably well supported. For the present session twenty have been arranged, and there is every prospect of interest being well maintained. An extensive programme of works visits has been arranged, and details will be circulated to members from time to time. The members are indeed grateful to those firms which so generously act as hosts to the Institute, and on their behalf the writer extends his sincere thanks. Later this year it is hoped that a representative body of members will accept the very cordial invitation received from the American Porcelain Enamelling Institute to visit the United States of America, where an attractive programme, including technical sessions, works visits, and social events has been arranged. Details of these will be available quite soon.

Industrial Conditions

Last year, the author prepared a very comprehensive survey of the industry, which it is hoped has been of some service to the industry. Whilst there has been some expansion, the period of one year is too small to warrant revision. New outlets for the products of the industry are continually being found, and the year 1937 was one of pronounced activity. This activity, however, was not free from difficulties, due to a large extent to the restricted supplies of the right type of metals. This is to be ascribed to the demands of the rearmament programme, which specially reacted upon the supply of cast-iron castings. This gave rise to increased experimenting, and more work has been done during last year in this direction than would normally take place in several years. Necessity as the mother of invention has been well exemplified in most plants.

The bath section of the industry has been exceptionally well employed, and the production registered probably constitutes a record. It is pleasing to note that the export position has been well maintained. Enamelled hardware, too, has also done well in the export market, in spite of the fact that imports continued to flood the home market. The falling-off in building has been exaggerated in certain directions, as the normal seasonal decline was much less noticeable than usual, and scarcely affected the fitted goods section, in which enamellers are most interested. One of the foremost gas-stove foundries has been mechanised during last year, which confirms the belief in the continued prosperity of this section of industry. Personal opinion is that enamellers can now look forward to this year being as good for business as was 1937.

The Malleable Castings Industry

(*Concluded from page* 27.)

The motor-vehicle industry continues to offer the biggest individual market for malleable castings, and there is every indication that the demand from this industry will continue to increase. The agricultural and shipbuilding trades have returned to more normal conditions, and have provided a further stimulus to malleable production in 1937. The light malleable castings industry has also enjoyed a very busy year, though there has been a tendency for the cycle trade to reduce its demands towards the close of the year.

With some prospect of stability in prices, the malleable industry in general can look forward with confidence to a good trading period in 1938. There has been a marked diminution of that inconsequent price cutting which was such a feature of the years of depression. Prices for widely varying classes of work have been more rational, compared with the past tendency to quote "average" prices. With the better trading conditions prevalent throughout 1937, the "fill the shop at any price" mentality has definitely receded into the background, though this, perhaps, is mainly attributable to a better understanding and application of costing systems.

Calculating the Composition of Moulding Mixtures

In practice, the choice of moulding mixtures is generally based on the results of trials. A theoretical method of calculating the composition of such mixtures is given by P. P. BERG and O.V. KOLACHEVA in "Liteinoe Delo," 7, 1937, in an endeavour to elucidate the variations occurring in moulding mixtures on account of the dehydration of the argillaceous or loamy constituents, which are the chief components subjected to the maximum alteration when heated. General formulæ are deduced for the content of dehydrated loam in moulding mixtures with and without regeneration of the mixture. Testing of the formulæ under practical conditions showed that the difference between the calculated quantity of loamy constituents after casting and the actual quantity found by analysis was less than 0.5 per cent.

Work of the Institute of British Foundrymen

By C. W. BIGG (President)

THE Institute of British Foundrymen was founded thirty-three years ago, by a few far-sighted foundrymen who realised that the time was rapidly approaching when the practical experience of the individual foundryman would have to be supported by a technique based upon scientific principles, and that mutual discussions of the problems of the trade would have to replace the secretiveness which existed in many branches of the industry. That the organisation they founded has contributed so much to the outstanding progress and developments in the industry is a wonderful tribute to their foresight and idealism.

Although there is, and always will be, room for still greater progress, the foundry industry, in the past thirty years, has shown wonderful developments. The Institute has actively participated in, and to a great extent guided, those developments, and can therefore claim to have contributed materially to the progress which the industry has made.

Membership Increase

This progress, which has been particularly marked in the past five years, is still continuing at a rapidly increasing rate, and it is not surprising, therefore, to find that an increasing number of foundrymen are appreciating that membership of the Institute is a necessity, and that during the last eighteen months the membership has increased by about 12 per cent., and now stands at the record figure of over 2,100.

THE INSTITUTE OF BRITISH FOUNDRYMEN.

OFFICERS, 1937-38.

PRESIDENT:
C. W. Bigg.

VICE-PRESIDENTS:
J. Hepworth, J.P., M.P.; W. B. Lake, J.P.

PAST-PRESIDENTS:
R. Buchanan. (Deceased, 1924.) 1904–1905.
H. Pilkington. (Deceased.) 1906–1907.
F. J. Cook, M.I.Mech.E. 1908–1909.
P. Longmuir, M.B.E., D.Met. 1910–1911.
C. Jones. (Deceased, 1923.) 1912.
S. A. Gimson. 1913–1914.
W. Mayer. (Deceased, 1923.) 1915.
J. Ellis. (Deceased, 1930.) 1916–1917.
T. H. Firth. (Deceased, 1925.) 1918.
John Little, M.I.Mech.E. (Deceased, 1932.) 1919.
Matthew Riddell. 1920.
Oliver Stubbs, M.I.Mech.E. (Deceased, 1932.) 1921.
H. L. Reason, M.I.Mech.E. 1922.
Oliver Stubbs, M.I.Mech.E. 1923.
R. O. Patterson, 1924.
J. Cameron, J.P. 1925.
V. C. Faulkner, F.R.S.A. 1926.
J. T. Goodwin, M.B.E., M.I.Mech.E. 1927.
S. H. Russell. 1928.
Wesley Lambert, C.B.E. 1929.
F. P. Wilson, J.P. 1930.
A. Harley. 1931.
Victor Stobie, M.I.E.E. 1932.
C. E. Williams, J.P. 1933.
Roy Stubbs. 1934.
J. E. Hurst. 1935.
H. Winterton. 1936.

HON. TREASURER:
S. H. Russell.

SECRETARY AND GENERAL OFFICE.
T. Makemson, Assoc.M.C.T., St. John Street Chambers, Deansgate, Manchester, 3.

In this connection it is interesting to note that though there is an expansion in all the several categories of the membership, the largest increase is in the full member section. Moreover, the very appreciable increase in the number of subscribing firms is evidence of the fuller recognition of the Institute's value to the industry. That the results of the work of the members of the Institute must be of benefit to every individual firm in the country is no idle claim, and I venture to suggest that the Institute is entitled to more general recognition from the firms comprising the industry than is represented by the number of subscribing firms at present recorded.

The principal activities of the Institute centre round the Branches. Probably few technical societies arrange so many meetings in the course of the year as this Institute, which holds meetings in about twenty cities and towns throughout the country. The bulk of the members, therefore, reside within reasonable distance of one of these centres, and are able to attend meetings, hear lectures, take part in visits to important foundries, and derive the benefits which accrue from making the acquaintance of their fellow foundrymen engaged in solving similar problems to themselves. An extension of the work of the Branches is the Annual Conference, which is organised by each Branch in turn, and at which Papers are presented by acknowledged experts in this country and from abroad.

MR. C. W. BIGG.

Technical Scope of the Institute

It cannot be emphasised too strongly that the Institute is interested in every branch of founding, iron, steel and non-ferrous. Naturally, a considerable proportion of the Papers deals with cast iron, and with practical foundry processes common to all branches of the industry, but serious endeavours are made to introduce Papers and discussions dealing with steel, malleable cast iron and non-ferrous work; at the last Annual Conference held at Derby, for example, a special session of non-ferrous Papers was arranged.

Committee Reports

Authors of Papers presented to technical societies naturally draw largely upon their own individual experience, but during the past few years the Institute of British Foundrymen has inaugurated the presentation of Papers prepared by a Committee. Six of such Papers have already been prepared and presented by the respective Sub-Committees of the Institute's Technical Committee, the most recent being a report of the Costing Sub-Committee of the Technical Committee, which consisted of a carefully thought-out system of foundry costing which it is hoped will be useful in assisting foundries to arrange a costing system on a uniform basis.

The Technical Committee also forms a liaison between the research work which is now carried out by the B.C.I.R.A. and other organisations, by various companies and by private workers on the one hand, and, on the other hand, the practical foundryman who wishes to apply this work to the problems with which he is faced from day to day. The Technical Committee is also the medium by which the Institute makes contact with other technical bodies and with the standardising institutions, and in this connection, attention is called to the valuable work which the Cast Iron Sub-Committee of the Technical Committee has recently done in connection with the preparation of two important British Standard Specifications, which it is understood are almost ready for publication.

The South African Branch

The Institute is, generally speaking, national in its scope. It has, however, many members in other parts of the world, particularly throughout the British Empire. Quite recently a number of members in South Africa, realising the value of membership of a technical institution such as this, have formed a Branch which holds regular meetings in Johannesburg. Although it has only been in existence some nine months, the Branch has a membership of about 70.

THE INSTITUTE OF BRITISH FOUNDRYMEN.

Members.

Honorary	18
Subscribing Firms	68
Members	879
Associate Members	1,005
Associates	120
Associates (Students)	29
Total	2,119
Branches	11
Sections of Branches	5
Junior Sections	1
Committees of Council and Special Comittees	7
Technical Committee and Sub-Committees	10
Technical and Educational Institutions on which the Institute is represented	11
Branch meetings during 1937	125

Papers presented in 1937.

Cast Iron	9
Steelfounding	6
Non-ferrous	14
Moulding, Coremaking and Patternmaking	24
Sands and Refractories	6
Furnaces and Fuels	7
Organisation	7
General Discussions	6
Branch and Section Presidential Addresses	14
Miscellaneous	9
Total	102
Nationalities represented in membership	12
Countries in which members are resident	19
Cities and towns in which meetings are held	22

The international aspect of the Institute's work is even wider than the contact with the overseas members, as it is associated through the International Committee of Foundry Technical Associations with the foundry technical associations in some twelve other countries, including the United States of America. These affiliations facilitate exchange of data between the various associations, and some of the associations, including this Institute, have a system whereby Papers by members of certain associations are presented at the Annual Conference, and annually an international conference is held in one of the countries represented on the Committee, at each of which some hundreds of foundrymen from various parts of the world meet

together to discuss problems of mutual interest. Incidentally, in the year 1939 the Institute of British Foundrymen will be the host for the International Conference, which will be held in London, and which will be followed by a tour to various industrial centres throughout Great Britain.

Technical Co-operation

There is considerable co-operation between the Institute and other technical institutions in this country. Joint meetings and discussions are held by many of the Branches with the corresponding local or provincial branch of other institutions. Similar meetings are occasionally held between the Institute as a whole and other institutions, and the Institute is represented on certain joint committees of technical institutions organised for special purposes.

A Qualifying Institute?

The development and progress in the industry has called into being processes and practices which were almost, if not wholly, unknown when the Institute was formed. The term "foundryman" has now a very different and wider application than it had thirty years ago. Contributory and necessary to what was known as the "foundryman" of those days, there are a number of parallel specialists, for all of whom the Institute must cater if it is to be truly and fully representative of the industry, and it has been realised for some time that there is room for considerable further development in the Institute and its activities. It is desirable that these developments should be planned and that endeavours be made for them to proceed on organised lines. A Development Committee was therefore created, which in due course submitted to the Council of the Institute a scheme for further development, which was accepted in principle. During the last year, an Organisation Committee has been engaged in formulating plans for putting into effect some of the recommendations of the Development Committee, and these plans are now before the Council of the Institute. If accepted, the proposals will place the Institute in a stronger position to continue and expand its work, and they will also have the effect of making membership of the Institute a qualification which will add to the prestige and value of the individual member.

Last Year's Work

The session 1937-38 commenced with a Conference at Derby, the technical and social arrangements for which were such as to give the greatest satisfaction and pleasure to all who participated. One of the most interesting features of this Conference was the initiation of the E. J. Fox medal. The first recipient was Emeritus Professor Thomas Turner, and it is fairly safe to assume that no more satisfactory choice for the award will ever be made.

I would like to take this opportunity of emphasising the indebtedness of the Institute to the civic authorities of Derby, and the many firms and individuals who contributed so much to this very successful occasion.

The International Conference in Paris was attended by a very large number of members, and the programme arranged by our French colleagues was in every direction such as to deserve the highest praise.

As mentioned previously, the principal activities of the Institute centre round the Branches, and it is very gratifying to note the enthusiasm which is evinced both by the attendances at the Branch meetings and the lively interest shown in the discussions on the Papers submitted.

Reference to the volumes of Proceedings for past years, or to the programmes of the Branches for the present session, is convincing evidence that in the Institute's activities every phase of foundry research, education and practice is dealt with in such a manner as to be of incalculable benefit to its members and the industry as a whole, and one does not hesitate to claim that every foundry in the country should be represented in the membership of the Institute.

The Pig-Iron Industry

By W. F. C. McCLURE (Director, Stewarts and Lloyds, Limited)

THE year 1937 has seen many changes in the prosperity of the industry. In the early part of the year producers were beginning to find that their stocks were being rapidly depleted. In fact, by the end of the first quarter stocks were so low that the position was dangerous.

In the meantime the production showed a substantial increase. The pressure commenced to ease off early in July, and although stocks at the end of the year were considerably below normal, there was no apparent shortage.

The situation has been affected to some extent by the inability of the building trade to obtain adequate supplies of some of their raw materials, as a result of which the demand for light castings for that industry has fallen off.

Another factor which undoubtedly has had some influence is price. The average price of No. 3 foundry iron delivered into the Birmingham district in 1935 and 1936 was:—

	Class 1.	Class 2.	Class 3.
	s. d.	s. d.	s. d.
1935.. ..	72 2	71 8	68 4
1936.. ..	80 6	78 0	75 6

The December, 1937, prices were:—

Class 1.	Class 2.	Class 3.
s. d.	s. d.	s. d.
113 6	111 0	108 6

The latter prices are, however, subject to a Loyalty Rebate of 5s. per ton, which is rebated to the consumer provided he purchases the whole of his requirements from members of the Foundry Pig-Iron Producers' Association.

This very substantial advance in price of pig-iron has been wiped out by the increase in the cost of raw materials, particularly blast-furnace coke, which has risen to a figure hitherto undreamt of. In fact, it may be said that in the last few months the price of pig-iron has been controlled by the producer of coke for blast-furnace purposes.

Production of Foundry Iron in the United Kingdom, showing Tonnage and Percentage of the Total Pig-Iron Production in each year from 1930 to 1937.

Year.	Output. Tons.	Percentage of total pig-iron.
1930	1,433,600	23.1
1931	1,153,600	30.6
1932	1,020,100	28.5
1933	929,100	22.5
1934	1,275,500	21.3
1935	1,325,800	22.6
1936	1,311,700	17·1
1937 (estimated) ..	1,550,000	18·0

Monthly Production of Foundry Pig-Iron in the United Kingdom during 1937.

Month.	Tons.
January	120,800
February	110,000
March	113,500
April	122,400
May	122,200
June	122,200
July	118,000
August	130,700
September	144,900
October	142,900
November	148,200
December (estimated)	154,200

United Kingdom Imports and Exports of Forge and Foundry Pig-Iron in the last Six Years.

Year.	Imports. Tons.	Exports. Tons.
1932	30,107	73,862
1933	37,693	54,029
1934	110,203	74,533
1935	67,431	92,728
1936	40,800	57,529
1937 (estimated)	103,480	91,050

United Kingdom Monthly Imports and Exports of Pig-Iron in 1937.

Month.	Imports. Tons.	Exports. Tons.
January	14,556	13,042
February	20,883	12,718
March	21,283	16,374
April	21,186	16,002
May	24,493	13,613
June	75,809	9,227
July	87,243	11,923
August	94,024	13,793
September	84,401	14,749
October	62,421	9,999
November	74,162	13,011

The future appears to be bound up almost entirely with the home market, where undoubtedly prospects are very favourable. It is, however, a matter for deep regret that the iron-masters have been unable to maintain their export markets, which have stood them in such good stead in the past, and it can only be hoped that it will be possible to reopen these in future, when iron is available.

Publication Received

Copper in Cast Steel and Iron. Issued by the Copper Development Association, Thames House, Millbank, London, S.W.1, as CDA Publication No. 29.

It seems to the reviewer rather ridiculous that such a book as this should not be sold, for unquestionably it is not only a reliable text-book on the subject but also a valuable one. Most of our readers will remember the excellent Paper (see the JOURNAL for November 4 and 11) on the subject of "Copper in Cast Iron and Malleable Iron" by W. B. Sallitt, and they will be interested to learn that this book augments the information therein contained as well as dealing in a similar manner with steel castings. Here the mechanical properties are shown to be considerably enhanced with copper additions between 1 and 3 per cent. The lowering of the impact resistance can be rectified by replacing carbon by copper for any required tensile strength. This rectification is really an amelioration, because for any given tensile figure the material will be tougher and more ductile. An important point from the foundry aspect is that copper additions yield a more fluid metal. The book is divided into eight chapters, supplemented by five appendices, four of which we deem to be superfluous as being readily available elsewhere. The whole of the 130 odd pages are thoroughly well illustrated, whilst the cross references used throughout will unquestionably be appreciated by readers. The book is available free of charge.

V. C. F.

Foundry Mechanisation

SOME CONSIDERATIONS ON CONTINUOUS-CASTING PLANTS

By A. WYNN (Director, Midland Electric Manufacturing Company, Limited)

MR. A. WYNN.

DURING recent years, with improving trade, much encouragement and incentive has been given to further mechanisation of foundries, with the result that to-day many excellent examples of well-developed schemes can be found in this country, dealing with most light classes of work.

A comparison of plants recently installed with those of a few years ago reveals improvement in almost every direction, substantial progress having been made in design, execution and operating technique, with the result that much of the earlier prejudice has been overcome.

To-day the intending buyer is much more critical as to prospective performance, and wisely demands a plant to suit his particular conditions, recognising that it is not sufficient to copy an existing plant or adapt a previous scheme, when quite special circumstances exist.

Generally speaking, there is much to be said in favour of a gradual approach, whenever possible, with a view to reaching complete mechanisation by stages rather than attempt to replace an entirely manual system by a fully-developed mechanical plant without intermediate experience.

Such a condition would normally develop by the application of moulding machines in the first instance, followed by a partial mechanisation, probably on flexible lines, using gravity

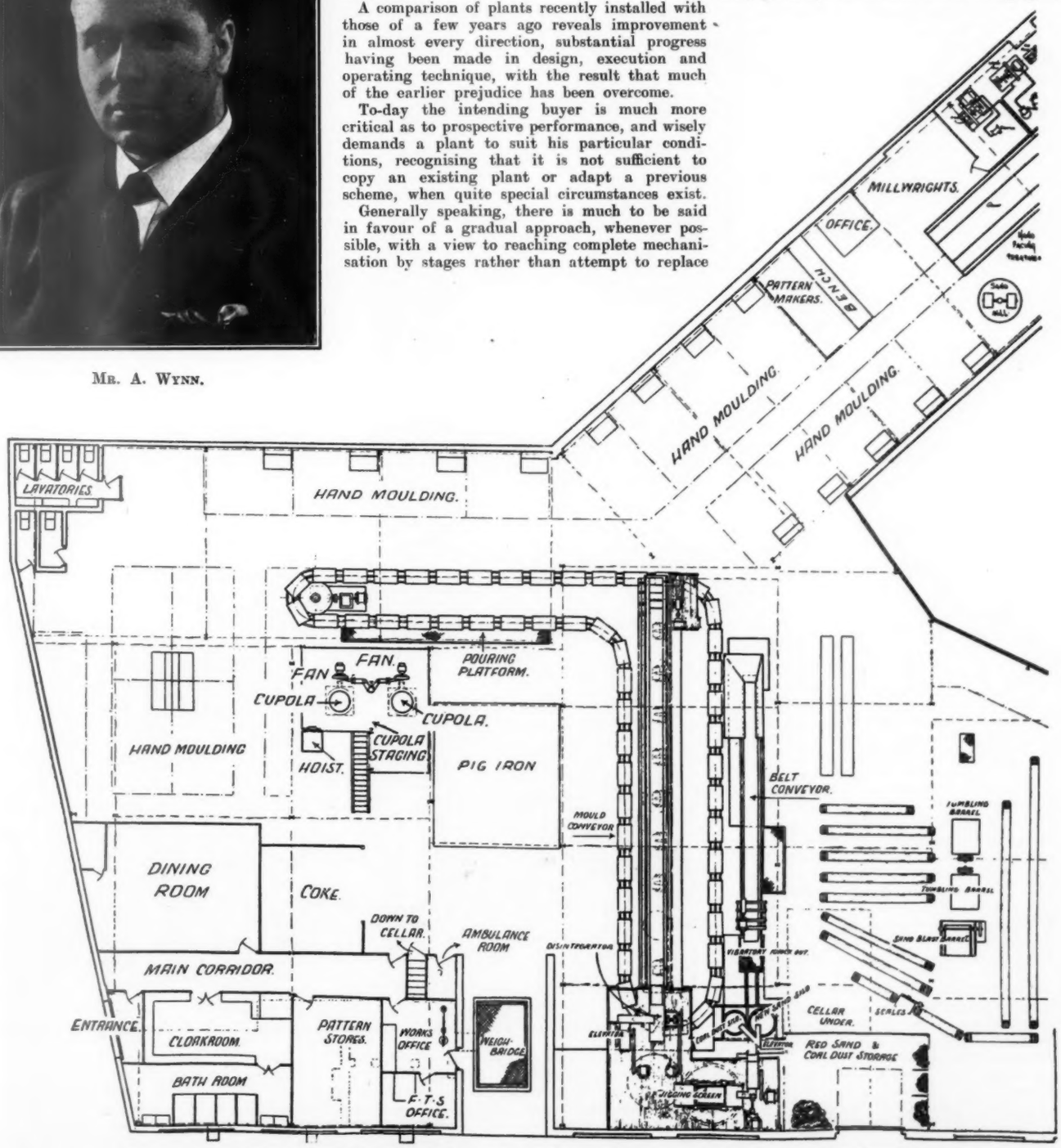
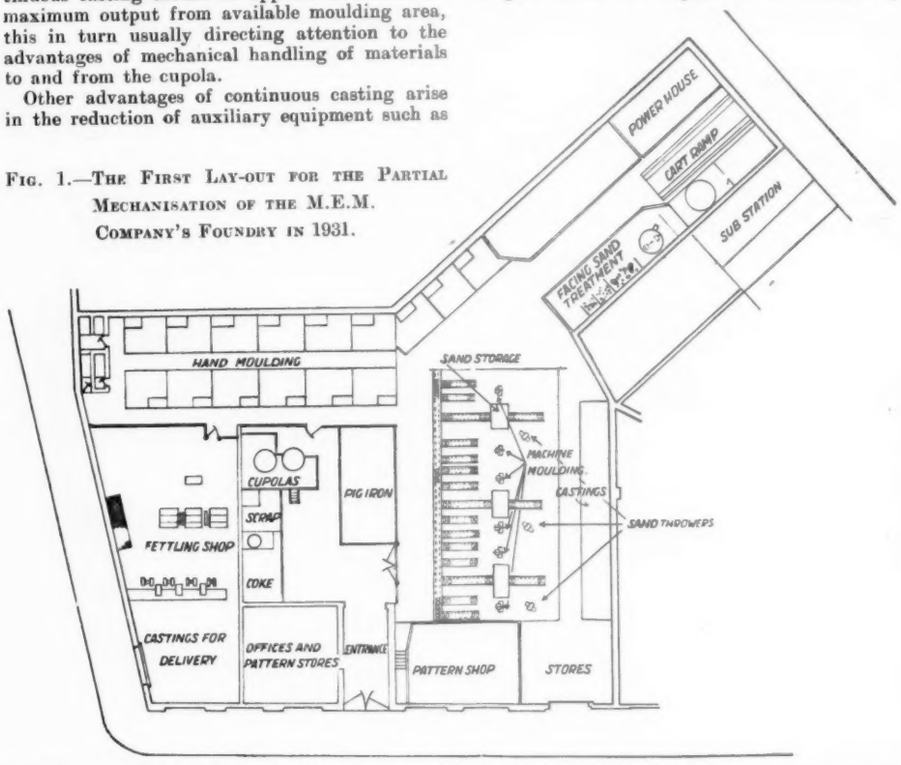


FIG. 2.—THE SECOND LAY-OUT DESIGNED IN 1933, SHOWING HOW ADVANTAGE WAS TAKEN OF SITE CONDITIONS.

roller conveyor for mould handling and simple sand treatment and handling arrangements. From such a system, as is shown in Fig. 1, performance data would be established and a fair idea obtained of results under more complete mechanisation. Wherever possible, continuous casting should be applied to obtain the maximum output from available moulding area, this in turn usually directing attention to the advantages of mechanical handling of materials to and from the cupola.

Other advantages of continuous casting arise in the reduction of auxiliary equipment such as moulding boxes and tackle due to the more rapid turnover.

FIG. 1.—THE FIRST LAY-OUT FOR THE PARTIAL MECHANISATION OF THE M.E.M. COMPANY'S FOUNDRY IN 1931.



When, in due course, a more comprehensive scheme is contemplated, the plant manufacturer should receive the fullest co-operation and guidance of the user, who will generally know most about his peculiar and special needs. A careful study of conditions and probable output is essential, and due allowance should be made for the increase in individual output which will generally follow successful mechanisation. Inspection of similar plants will often give guidance, and most foundries are agreeable to such visits if reciprocation is offered.

In the hands of the plant designer most schemes are capable of more than one arrangement, but simplicity can safely be the guiding principle in a final selection. Site difficulties usually arise, but these are rarely insuperable and can often be the cause of some unexpected improvement in the layout.

In an early plant with which the writer was associated the difficulties appeared great due to the short length of the shop intended for the machine bay, which, incidentally, contained cellars at one end, whilst the cupolas were in another section of the building which was relatively narrow. By opening up the cellars an excellent situation for sand mills and elevators was created, reducing foundation costs considerably, whilst the short length of the machine bay and disposition of cupolas were exploited to advantage by turning the track of the mould conveyor to form a right angle, crossing in front of the cupolas and arranging a contracted loop at this point which was ideally suited for pouring and weighting. Such a layout is shown in Fig. 2 (see previous page).

In comparing later plants with their predecessors, there is no doubt that improved design and selection of materials have definitely tended to reduce maintenance cost and increase life, both very important factors. The use of anti-friction bearings, ball or roller, is now almost universal, thus eliminating much of the previous constant greasing, whilst the great attention to bearing closures and careful protection from shedding sand should also be of great benefit.

Relatively high maintenance on chains, belts and gear wheels has emphasised the desirability of individual drives wherever possible, arranged so that motor, gearbox and driven member are directly coupled. Ample margins on gearboxes and motors are now generally recognised as necessary, and mechanical protection by shear pin device is usually incorporated. More attention might well be given to the ready replacement of wearing parts such as ploughs on feeders, plates on push-plate conveyors, and scrapers of all types. Sometimes through lack of means for adjustment the type of fixing precludes long life, or else a new wearing position can only be obtained after much troublesome dismantling.

High standards of cleanliness are made possible by the attention now given to prevent sand loss throughout the system, involving generous use of suitable shields, guards and protective casings, whilst the provision of ample platforms, stairs and walkways allows no excuse for poor supervision. In this latter connection, it is now fully realised that such mechanical units demand the same care and attention as any other intricate machinery, and well-organised cleaning and maintenance are essential for trouble-free working. It is not always sufficient to leave these matters to be dealt with as opportunity offers; the better practice is to draft a carefully-prepared schedule for the systematic cleaning of every section at suitable specified times, and as far as possible arrange for maintenance attention on a similar basis, and this only by authorised persons.

Safety and Welfare

Proper installation on well-prepared foundations with adequate access and lighting, particularly to those sections below ground, has encouraged the adoption of white glazed brick or suitably painted walls in these parts, together with well-planned lighting, usually with bulkhead fittings. The desirability of electrical plug points for portable lighting and power appliances needs no emphasis, and when scheming the lighting system such plug points can usually be conveniently incorporated so that, later, such tools as electric drills or hand lamps can be used on any part of the equipment without difficulty.

Together with mechanisation arises the need for due and proper attention to safety from the operator's standpoint, in order that the accident risk may not increase. The plant supplier is usually quite conscientious in this matter, but cannot always foresee the ultimate manner in which the process may be operated in every detail. For this reason a careful survey will sometimes reveal danger in most unforeseen places and additional guards or safety switches may be well justified.

In connection with the safety and well-being of the worker, it is interesting to notice how frequently, when introducing mechanisation, the opportunity is taken to improve the general conditions of the operatives. Such matters as lavatory and washing facilities, canteen and cloakroom accommodation are to-day receiving well-merited attention, and in general it can be said that improved conditions are desirable when such changes in method take place.

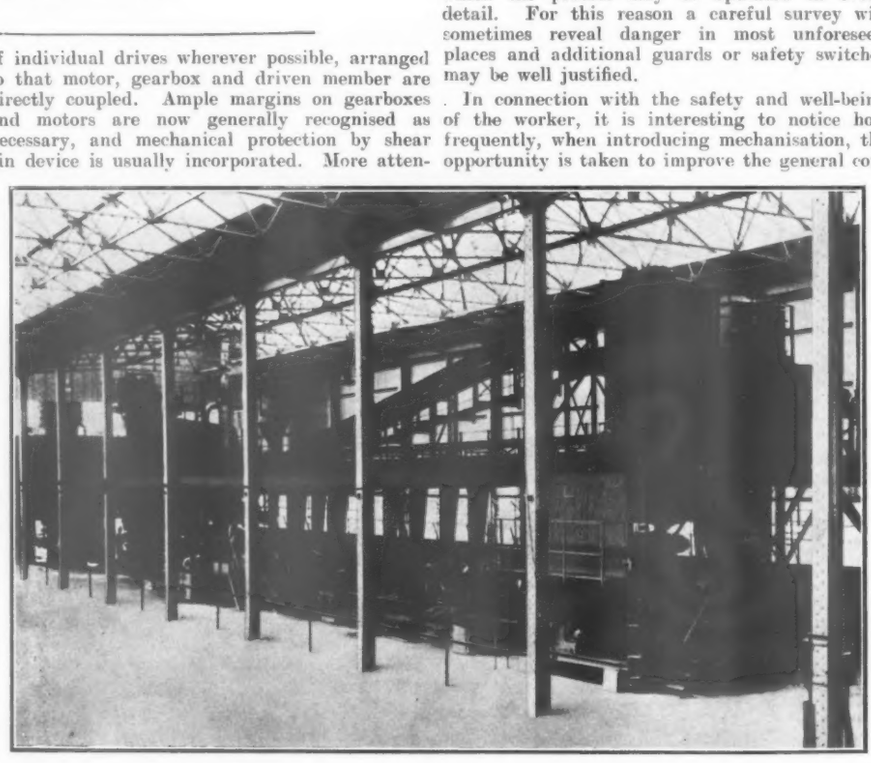


FIG. 3.—GENERAL VIEW OF NEW FOUNDRY AND PLANT COMPLETED IN 1937.

Recent Developments in Non-Ferrous Foundry Practice

By FRANK HUDSON

THE year 1937 has proved a very busy one for British non-ferrous foundries and it has closed with production at full capacity and order-books well filled. Unlike the ferrous interests, there has been no shortage of raw materials, but the industry has been handicapped to some extent by the excessive rise in the price of metals, particularly towards the close of the first half-yearly period, due to speculative dealing rather than normal trade requirements. The only exceptions to this statement have been nickel and aluminium, and it is interesting to note that the reduction in the price of the former metal, announced in the first issue of the JOURNAL for 1937, has been maintained over the whole year, even when other metal prices fluctuated widely. In the case of aluminium the price has remained unchanged since the end of 1932. It will also be observed from published statistics that the use of these two metals has been increasing at a considerably greater rate than other non-ferrous metals. The world demand for nickel and aluminium in 1936 showed a very large increase over the boom year of 1929, whilst the consumption of copper and zinc rose only 1 per cent. and 4.8 per cent. respectively. Tin and lead, on the other hand, showed a decrease of 6 per cent. and 7.2 per cent.

Increased activity has not led to any startling new developments in foundry equipment as a whole, although greater progress has been made in improving the finished product. A few firms not too severely hit by the late depression have seen fit to re-modernise their brass foundries, but in general the natural tendency has been to allocate profits to depleted reserve funds in order to ensure that necessary cover for adverse times. It can, however, be confidently expected that if industrial prosperity continues a greater expenditure on new plant will be forthcoming in the near future. Foundries supplying the requirements of the motor-vehicle and aircraft industries are an exception to this statement as in view of the rapid developments in this field nothing but the best in both equipment and materials can be acceptable.

FOUNDRY EQUIPMENT

Melting

On the whole there have been few outstanding developments during the year on the equipment side. In connection with melting furnaces oil- and coke-fired crucible units remain the popular fancy, and as they undoubtedly lend themselves to British production methods they will be difficult to displace. The reason for this preference is due to the fact that the average non-ferrous moulder is usually responsible for melting his own metal as well as making moulds. Such methods are not conducive to economic production nor to maximum quality of product, and this aspect is commended for serious consideration.

It should be kept in mind that the modern forced-draft coke-fired crucible pit-furnace has developed to a high state of perfection and will melt two and a-half to three times as fast as natural-draft furnaces, and the installation of such units in any re-organisation scheme entails a complete review of metal handling methods if such equipment is to be used to the best advantage. As an example, it might be pointed out that one non-ferrous foundry replaced twelve natural-draft pit fires last year with four forced-draft units and actually increased production by arranging that these should be operated by a separate melting squad. The moulders, relieved from this work, found time to increase their output of moulds. Further extension of this idea is to the direct advantage of the industry as a whole, and paves the way to thought being given to more advanced methods of melting (*i.e.*, electric furnaces, etc.), which up to now have not received the consideration they merit.

Coincident with improvements in forced-draft furnaces, well-known coke suppliers have placed on the market cut and graded hard furnace coke of approved quality particularly suited for service in such furnaces. The advantages resulting from this development are obvious, as it reduces labour costs entailed in breaking up this type of fuel in the foundry, minimises wastage due to fines and results in more efficient melting practice. For the majority of furnaces used in non-ferrous foundries a coke size between $1\frac{1}{4}$ and $2\frac{1}{4}$ in. is to be preferred.

MR. FRANK HUDSON.

Furthermore, during the past year crucible manufacturers have been by no means idle, and have developed super plumbago crucibles having greatly improved properties over those previously supplied. These are characterised by having greater heat conductivity, which not only facilitates rapid melting but also minimises local heating and the consequent reduction of stresses leading to premature cracking and failure. Whilst such crucibles are somewhat higher in initial cost, their greater life in practice results in an actual economy being ultimately obtained, as will be observed from the data given in Table I. These results were arrived at by actual trial under normal brassfoundry conditions in forced-draft coke-fired furnaces melting the more common gunmetal and yellow brass alloys. In view of the fact that these super crucibles heat more rapidly, they also cool faster than the ordinary product, and consequently more rapid pouring methods are advisable. Accordingly they are not recommended, nor for that matter needed, for receiver crucibles as used for the disposal of molten metal from tiling furnaces, etc.

TABLE I.—*Cost Comparison of Ordinary and Super Plumbago Crucibles.*

Type of crucible.	Number of heats obtained.	Approximate price ratio per crucible.	Average cost per heat.
Ordinary ..	73 to 94	1.0	2.5d.
Super ..	142 to 156	1.33	1.9d.

Moulding and Coremaking

No outstanding development has taken place in this direction during the past year, although there is a definite tendency for many foundries to adopt machine moulding methods to a greater extent than previously for the production of the smaller non-ferrous castings in green sand. On the whole the brassfounder is considerably behind the ironfounder in this method of production, and has much to learn. Due to the type of sand normally used, jarring machines do not seem to give the best results. This can be accounted for in most cases through the fine texture of the sand employed and consequent lack of "flowability." Accordingly plain squeezing or jolt-squeeze machines, with or without pattern turnover, are being increasingly employed with satisfaction. Machine-moulding methods in non-ferrous practice generally entail the use of heated metal pattern plates in order to ensure high mould finish and accurate reproduction of fine detail.

A greater number of foundries are giving attention to sand control, but here again the non-ferrous founder is behind the ironfounder, and a livelier interest is indicated if the best results are to be obtained. The extended use of machine moulding will do much to correct matters in this direction. During the year the writer drew attention to the advantages to be gained through a knowledge of the heat conductivity of mould materials for the manufacture of non-ferrous castings and the consequent possibility of obtaining controlled cooling. This is likely to be of prime importance in the production of commercial castings in those metals or alloys which readily absorb gases during melting, such as copper, nickel and nickel-containing alloys, as rapid cooling minimises gas evolution during solidification and promotes density.

The chilling effect obtained from moulding compositions of this nature, made from a graphite or carborundum base, is most marked, as will be observed from Fig. 1, which illustrates a comparison of the structure of 4 per cent. nickel-copper castings, as used in the electrical industry, when made in this way and by more usual methods. It is interesting to note that the value of such moulding compositions has been recently confirmed by W. H. Salmon* in other directions. During the period under review at least one important foundry has become interested in the manufacture of large non-ferrous castings from cement-bonded moulds by the Randupson process.

The question of sand handling has proved something of a problem to those foundries who have considered this matter during the year, and help is needed from equipment manufacturers in order to evolve some suitable means of reclaiming small particles of non-ferrous metals from the returned sand. Obviously, the methods commonly employed in the iron foundry are quite unsuitable, and at present recourse has to be made to hand sieving in many cases to obtain the results required.

In core manufacture the use of oil sand is extending in conjunction with the development of core-blowing machines and vertical continuous drying stoves, this latter piece of equipment rapidly becoming popular with discerning foundrymen.

Other Equipment

During 1937 increased attention has been given to cleaning methods, both for castings and the

* FOUNDRY TRADE JOURNAL, December 2, 1937, p. 427.

treatment of scrap. The airless shot blast has proved to be very suitable for the fettling of castings, and a new self-cleaning shute type of magnetic separator has been brought out for the treatment of borings and swarf, as shown in Fig. 2. It is reported that this latter machine is more efficient than the drum type of magnetic separator which has hitherto been the most popular piece of equipment for this service. It is designed for continuous operation and essentially consists of a stationary electric magnet made up of a series of alternate polarity poles over which runs an endless belt fitted with

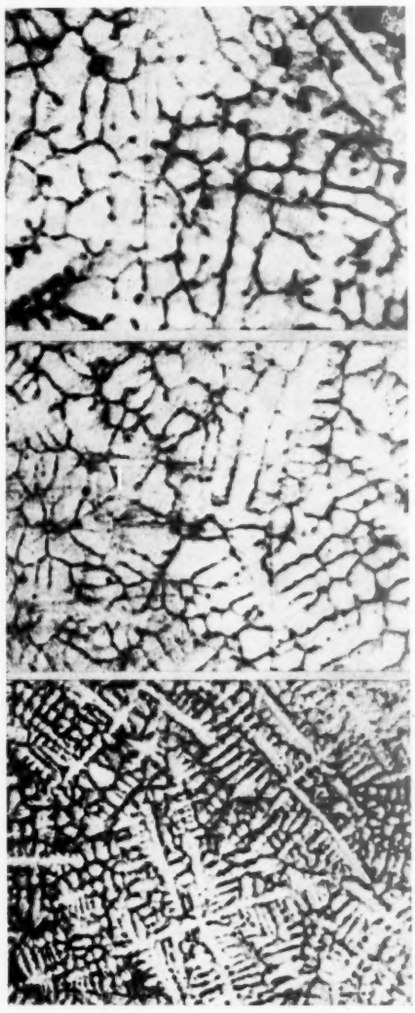


FIG. 1.—EFFECT OF MOULD MATERIAL ON MICROSTRUCTURE OF 4 PER CENT. NICKEL COPPER (1-IN. DIA. BARS CAST AT 1,275 DEG. C.). × 50.

Top: Cast in Dry-Sand Mould.

Centre: Cast in Green-Sand Mould.

Bottom: Cast in Graphite-Base High-Conductivity Moulding Composition.

feelers. The belt is driven in a direction opposite to the gravity flow of the swarf, and the feelers become highly magnetised by induction, thereby attracting iron particles which are held until they pass a neutral point beyond the top position of the belt. It will be appreciated that this machine is primarily designed for the treatment of swarf and borings, and when light scrap has to be handled, the usual rotary drum type is still to be preferred.

In view of the importance of temperature control in the production of non-ferrous castings, the question of pyrometers is another point worthy of close consideration in a review of 1937. Practical experience indicates the suitability of the bare wire immersion type for rapid and accurate control of pouring temperatures up to 1,400 deg. C. There is, however, some difficulty in obtaining apparatus of this design capable of practical application for the handling of the higher melting point alloys, and it is interesting to observe that a thermo-couple composed of carbon and silicon-carbide (carborundum) is now commercially available in the United States. It consists of a tube of compressed carbon with a rod of silicon-carbide down the centre, and the thermo-electric power generated is approximately 30 times that of the platinum—platinum-rhodium couple and five times as great as the iron-constantan couple, and will measure temperature by direct immersion up to at least 1,800 deg. C.

METALLURGICAL DEVELOPMENTS

At the annual conference of the Institute of British Foundrymen in Derby last June, non-ferrous topics were well to the fore and several excellent Papers of direct practical interest were presented. The Third Edward Williams Lecture so ably delivered by Dr. C. H. Desch, entitled "Physical Factors in the Casting of Metals," is particularly worthy of mention, as it throws light on such properties of molten metals as "flowing power," viscosity, surface tension and other factors of outstanding importance in the production of castings, and indicates the direction for future research in connection with these matters. Trends in the non-ferrous foundry were fully reviewed in a Paper by Dr. L. B. Hunt, and other interesting and instructive non-ferrous Papers were presented by Hall, Hitchcock and Professor Chaudron. The Paper by the last author on "The Problem of the Elimination of Gaseous Impurities from Aluminium" is worthy of further study, as it introduces a new method of determining the nature and amount of gas absorbed by metals and alloys. The sample to be tested for gas content is made the cathode in a discharge tube and subjected to the action of a high-tension electric current when the gas contained by the metal is released. It is quite unnecessary to bombard the whole of the surface of the sample with the high-tension charge, as it has been found possible, for example, to extract all the gases from a long aluminium wire by introducing a very short length into the tube. Using this method, it has been found that the amount of gas contained by aluminium is very much greater than previously recorded by the more common method of heating in vacuum. Furthermore, after the gases have been released by the metal, they can be readily analysed, and it would appear that the testing procedure could be well applied to the investigation of other metals, such as copper and nickel, etc., in view of the important part occluded gases play in the founding of these alloys.

The use of fluxes in melting is becoming of increased importance as it is now appreciated that they can form slags which react with the molten metal to give improved physical properties. The opinion of most foundrymen in the past has been very sceptical on this point and the investigations of Lepp and others have done much to indicate their field of usefulness. For example, in the melting of Monel, nickel silver and nickel bronzes it has been found that a manganese-ore slag prevents the absorption of hydrogen, carbon and sulphur, all of which are decidedly detrimental to the successful founding of these alloys. It would appear that the oxides in manganese ore evolve a small amount of free oxygen on heating and this combines with hydrogen, or reducing gases such as carbon-monoxide, which are readily soluble in nickel alloys, to form other gases which are insoluble. Furthermore, manganese-base slags exert a very powerful desulphurising action.

Using properly balanced fluxes as degasifying agents, Lepp has improved the ductility of gunmetals and bronzes to a high degree, obtaining elongation values of from 40 to 70 per cent. on 88 : 10 : 2 gunmetals, as will be observed by a study of the publication No. 3 Series D* issued by the International Tin Research and Development Council during the year. It has also been suggested that dissolved gases cause inverse segregation in non-ferrous alloys and consequent irregularity in composition, and an able review on this problem was given in 1937 by Vaughan of the British Non-Ferrous Metals Research Association to the autumn meeting of the Institute of Metals in Sheffield.

The development of high-duty brasses and bronzes has progressed rapidly during the past twelve months and a variety of commercial alloys are now available with a wide range of useful properties. The copper-base alloys containing nickel and tin, or nickel and aluminium, susceptible to temper or precipitation hardening are of outstanding interest. It is rather remarkable to observe that an alloy containing 5 per cent. nickel, 5 per cent. tin, 2 per cent. zinc, and balance copper, which "as cast" will give a tensile strength around 22 tons per sq. in.

[*Courtesy Rapid Magnetting Machine Co.*

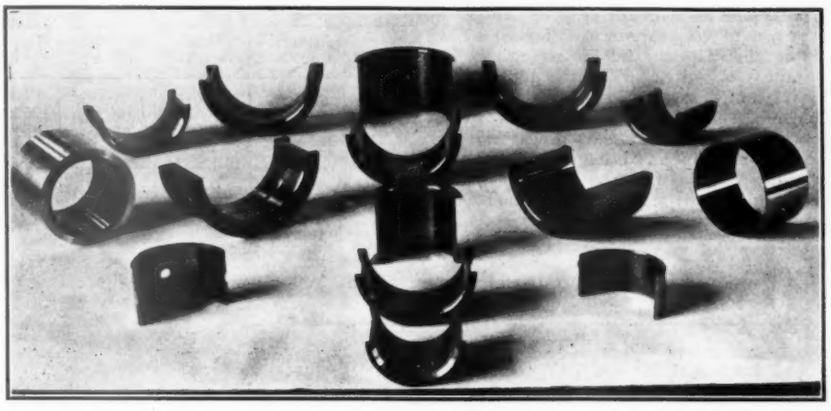
FIG. 2.—NEW SHUTE-TYPE MAGNETIC SEPARATOR FOR THE TREATMENT OF SWARF AND BORINGS.

and a Brinell hardness of 75, can be simply heat-treated to give up to 40 tons per sq. in. and 200 Brinell, respectively. The nickel-aluminium-zinc alloys exhibit similar properties, and there are many high-duty parts in all branches of engineering which could be profitably made in non-ferrous materials of this class. A notable contribution to existing knowledge in connection with cavitation erosion of high-duty bronzes as experienced on marine propellers, pump impellers, etc., was published in the Transactions of the American Society of Mechanical Engineers for July, indicating the effect of composition and physical properties in minimising this trouble. In the motor-vehicle industry the use of another precipitation hardening alloy, namely chromium-copper, has been suggested for cylinder-head castings.

The Discussion on Lubricants and Lubrication organised by the Institution of Mechanical Engineers in London towards the close of the year brought the question of bearing metals into the limelight and indicated the lines along which future progress might be made. Apparently the ordinary tin-base alloys are susceptible to fatigue failure under modern high-speed conditions, particularly so far as aircraft and motor-vehicles are concerned, and new or modi-

* See also FOUNDRY TRADE JOURNAL, October 21, 1937, p. 321

fied alloys are needed. Steel-backed copper-lead bearings showed promise for operation with hard and semi-hard shafts, but in general a more economic casting technique has still to be evolved in order to further their more extended use.

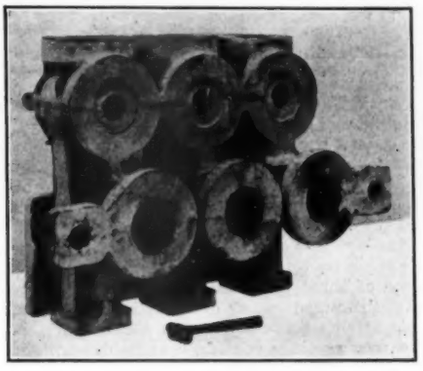


[*Courtesy Glacier Metal Co., Ltd.*

FIG. 3.—GROUP OF STEEL-BACKED COPPER-LEAD BEARINGS FOR AUTOMOBILE AND AIRCRAFT ENGINES.

It is interesting to note that this application possibly embraces the smallest sectioned high-duty non-ferrous casting produced, as the copper-lead alloy is only around $\frac{1}{16}$ in. thick and calls for particular skill in manufacture. Fig. 3 illustrates a group of such bearings for Diesel and aircraft engines, and it is interesting to compare them with the large high-tensile brass marine pressure casting shown in Fig. 4. Both these castings are outstanding examples of their respective type and call for the highest skill in founding. Latest research in this country and on the Continent indicates the possibility of developing aluminium alloy bearings for motor-vehicle and aircraft service.

Space does not permit mention of other developments during the year but the foregoing will suffice to indicate that in the period under review non-ferrous foundry developments have been active and although there are some who feel that the inevitable slump is just around the corner (and will be upon us when armament orders cease), many look forward with confidence to continued prosperity in the New Year.



[*Courtesy G. & J. Weir, Ltd.*

FIG. 4.—LARGE NON-FERROUS PRESSURE CASTING IN HIGH-TENSILE BRASS.

Marine Engineering Foundrywork

By COLIN GRESTY (Foundry Manager, The North Eastern Marine Engineering Company, Limited)

LOOKING back over the past two or three years, the outstanding feature relating to foundries which are dependent primarily on shipbuilding and marine engineering is, of course, the great change from a period of low output to one of high output. Following several years of very severe depression, during which business was at such a low ebb that many foundries were closed down and dismantled, there arose an increased demand for ships and engines of all types.

An indication of the extent to which mercantile shipbuilding had declined and the revival which has taken place is given in Table I, taken from the latest Report of Lloyd's Register of Shipping. The figures cover all ships classed by the Register during the years stated.

TABLE I.—*Annual Tonnage of Ships Built from 1927–1937.*

Year.	Tonnage.
1927–1928	1,875,068
1928–1929	1,737,736
1929–1930	1,804,246
1930–1931	1,734,089
1931–1932	915,264
1932–1933	447,150
1933–1934	348,197
1934–1935	752,200
1935–1936	1,001,806
1936–1937	1,335,883

It will be observed from these figures that although the recovery in mercantile work has been very considerable, the level has not yet reached that of the years from 1927 to 1931. On the other hand, however, in assessing the increased activity it should be borne in mind that the amount of naval work has also risen greatly during the last year or two.

Shortage of Skilled Men

The period of rapidly expanding output has not been without difficulty for the foundries, due chiefly to the shortage of skilled labour and of normal supplies of pig-iron, scrap iron and other materials. The shortage of skilled men has been felt acutely in the shipbuilding districts, and there have been times when it has been impossible to obtain the number of men required. Some months ago, for example, the foundry with which the writer is connected found itself unable to get sufficient loam moulders experienced in marine work, in spite of the efforts of the Employment Exchanges in the various districts.

MR. COLIN GRESTY.

In order to relieve the position it became necessary to reorganise certain of the work in such a way that some of the castings, normally made in loam, could be transferred to sand moulding.

This shortage of skilled labour is largely due to two causes. In the first place, during the years of depression many of the men, and particularly the younger ones, left these districts for the Midlands and the South, where work was available in the lighter industries. Secondly, on account of the closing down of some foundries and the low level of production in others, the number of apprentices trained during the last few years has been considerably below normal. In the writer's opinion, it is a matter of the utmost importance to the marine engineering industry that an adequate number of apprentices should be constantly employed, as the class of work demands a high degree of skill and craftsmanship. Moreover, it does not lend itself to any notable extent to methods of production by semi-skilled and unskilled labour such as have been applied successfully in many branches of the foundry trade.

Raw Materials

Turning to the question of materials, the position became very difficult at one period a few months ago. Supplies of pig-iron from the usual sources became more and more difficult to obtain, and many foundries were obliged to purchase foreign pig-iron in order to keep going. Whilst it would appear that home manufacturers of pig-iron have now overcome this temporary shortage and that adequate supplies will be available in the future, prices are still being steadily advanced. Coke supplies also have tended to be short, leading to too much "hand-to-mouth" working for busy foundries, and it is regrettable that, as in the case of pig-iron, the price of coke continues to rise.

The re-armament programme is, no doubt, largely responsible for this position, and unfor-

tunately its effect on mercantile shipbuilding is proving serious and far-reaching. The shortage of supplies of steel plates and sections in particular has led to a gradual slowing down of the delivery of ships, and this, together with the high prices prevailing for all material, has resulted in a notable falling off in forward orders for new tonnage.

Increasing Use of High-Duty Iron

The last review which appeared in the FOUNDRY TRADE JOURNAL on the subject of shipbuilding and marine engineering was given by Dr. J. W. Donaldson three years ago, when he dealt in a very comprehensive manner with the application of both ferrous and non-ferrous foundry alloys in various branches of the industry. The writer, therefore, does not propose to deal with this aspect of the matter in detail, as it will be appreciated that in the comparatively short period of three years the position in this respect has not changed to any great extent. In general terms it may be said that the demand for high-duty iron castings continues to increase, mainly because of the popularity of the Diesel engine. A secondary factor contributing to the strong position of high-duty cast iron is its greater use in modern steam engine practice for those parts subject to high temperatures and/or wear.

Chiefly as the result of competition from the Diesel engine, a great deal of work has been done towards improving the efficiency of the steam reciprocating engine and reducing its fuel consumption. It is, indeed, of considerable interest to compare the modern steam-driven cargo vessel with its predecessors of, say, seven and fifteen years ago. The improvements are the result of the joint efforts of shipbuilders and engineers, the former having so developed the lines of the ships that less power is required to drive them and the latter having produced machinery of higher efficiency and lower fuel consumption. Also, a great deal of progress has been made in the design of propellers. The effect of this co-operation is illustrated very clearly in Table II, in which are given com-

TABLE II.—*Showing Increased Engine Efficiency since 1922.*

	1922.	1930.	1937.
Power required by ship, I.H.P. ..	1,900	1,650	1,400
Weight of main engines, tons ..	120	105	90
Total steaming weight of machinery installation, tons	530	480	430
Coal consumption per I.H.P. per hour, lbs. ..	1.5	1.35	1.05
Coal consumption per day, tons ..	30½	24	15¾
Coal consumption per voyage of 30 days, tons ..	915	720	472

parative figures of horsepower, coal consumption and weight of engines for typical examples of cargo vessels of the same carrying capacity (9,000 tons) and speed (10 knots), built in 1922, 1930 and 1937 respectively.

From the figures given, it will be appreciated that the modern vessel has much less fuel to carry than the earlier ones. Therefore, it has not only a greatly reduced fuel bill, but is also able to take some hundreds of tons more cargo.

The accompanying illustration shows a reciprocating engine of the latest design and it will be observed that both the h.p. and m.p. cylinders are of the poppet-valve type. Superheated steam is taken from the boilers at 750 deg. Fah. and, by means of a patent "reheating" arrangement, part of its superheat is used in raising the temperature of the exhaust from the h.p. cylinder before it enters the m.p. cylinder. Actually the steam enters the h.p. cylinder at a temperature of 600 deg. Fah. and the reheating system ensures that the steam to the m.p. cylinder is also superheated to such an extent that even the exhaust from the l.p. cylinder is dry.

In this particular engine, the h.p. and m.p. cylinder-liners, poppet-valves, valve cages and sleeves are all of Lanz Perlit Iron, which in the writer's experience has, during the past 11 or 12 years, proved very satisfactory for high duty castings for both steam and diesel engines.

From the point of view of the foundry industry, it is of interest to study the effect of developments such as those described above. In the first place the total weight of castings for a given size of ship has been considerably reduced and, secondly, the standard of quality has been raised to meet the ever-increasing demand for greater efficiency. These factors apply, of course, to all types of marine engines, whether reciprocating, turbine or diesel, and for the foundry mean in general more difficult castings, lighter scantlings, better quality material and more rigorous inspection.

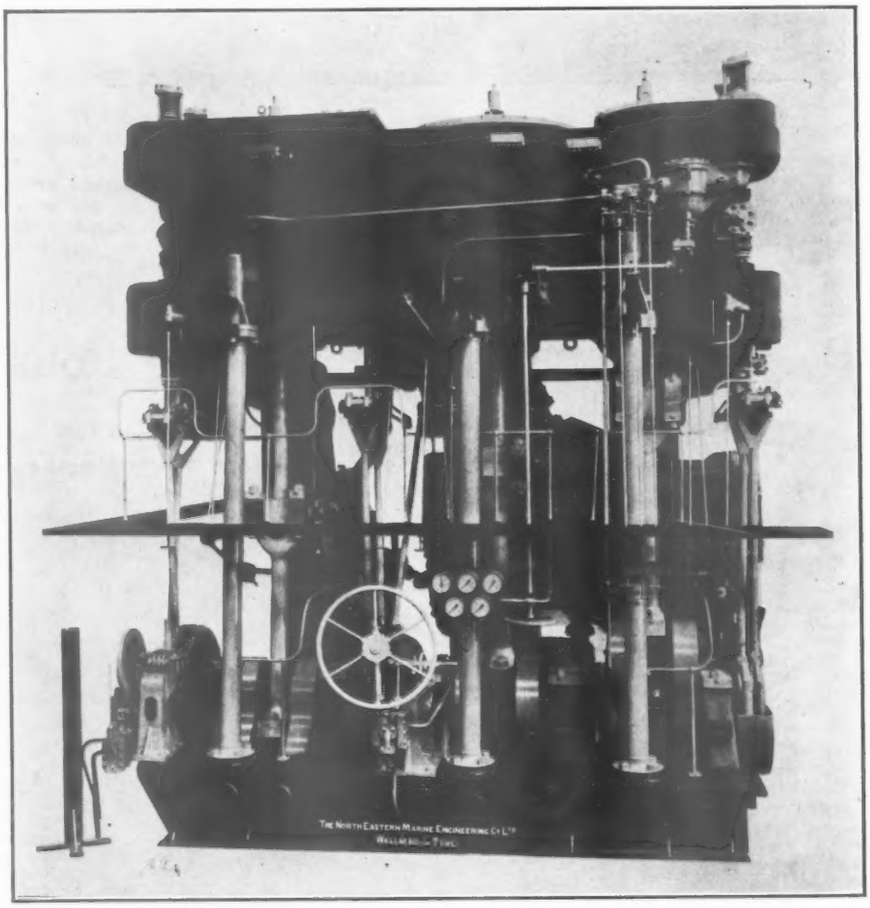
In conclusion, the writer would like to mention one other side of marine engineering work, viz., the production of cast-iron propellers. It is well known, of course, that to obtain the highest efficiency and also the greatest freedom from corrosion and/or erosion, a propeller should be of high-tensile brass or, as it is more generally termed, bronze. As a result, the size and importance of the cast-iron propeller business is liable to be overlooked, and one sometimes hears references to it as though it is almost a thing of the past. That this is far from being the case, however, will be seen from Table III, in which particulars are given of the propellers produced during the last twelve months by three foundries on Tyneside.

From the above figures it will be observed that in three foundries alone the total production of cast-iron propellers during the past year has amounted to 426, weighing 2,559 tons. A further noteworthy feature is that the 19¼-ton casting referred to is believed to be the heaviest cast-iron propeller which has ever been made.

TABLE III.—*Production of Cast-Iron Propellers in Three Tyneside Foundries.*

Foundry	No. of propellers.	Total weight.	Maximum diameter.	Maximum weight.
		Tons.	Ft. in.	Tons.
No. 1 ..	184	1,140	19 0	15
No. 2 ..	146	771	19 6	19¼
No. 3 ..	96	648	19 9	14½
Total	426	2,559	—	—

In the writer's opinion, the use of high-duty cast iron offers definite scope for further development in propeller manufacture. Cast-iron propellers can be produced much more rapidly than bronze ones and at a fraction of the cost, so that there is a wide margin for possible improvements whilst still keeping the cost much below that of bronze. In his own experience, the use of metal having a minimum tensile strength of 16 tons per sq. in. and a modulus of rupture of not less than 28 tons per sq. in. has proved successful, and advantage has been taken of the strength of the metal to reduce scantlings and thus save weight. Also it is to be anticipated that the employment of high strength cast iron such as that mentioned above, or higher as further progress is made, will increase the resistance of the material to the destructive effects of erosion.



TRIPLE-EXPANSION REHEAT RECIPROCATING ENGINE OF LATEST DESIGN, 23-66-38 × 45-IN. STROKE, IN WHICH LANZ PERLIT IRON IS USED FOR VITAL PARTS.

The Die-Casting Industry

By Dr. ARTHUR STREET (Fry's Diecastings, Limited)

READERS of this JOURNAL may sometimes have wondered whether this "die-casting" is an industry likely to render the ordinary foundry product unnecessary and obsolete. It is hard to be prophetic on such a subject; but possibly the solution to the question is that die-casting is revealing, and will continue to reveal, certain weaknesses of foundry work, but that the general trend of die-casting will be to stimulate the foundry trade. Just as the advent of the motor-car was accompanied by an eventual increase in the number of horses in use, so it may be assumed that both die-castings and foundry castings will work side by side, each with its own increasing applications and possibilities.

The die-casting industry has been chiefly associated with the development of new amenities; vacuum cleaners, for instance, could not have been sold in such large quantities at such reasonable cost were it not that the aluminium parts are produced as die-castings. The cheapness and smart appearance of the modern motor-car owes much to the industry, and one could go on indefinitely citing instances where die-casting has helped in the wider sale of a popular article, so that eventually the consumption of both the die-castings and the foundry castings involved in the manufacture has been considerably augmented.

The general principles of die-casting are by now well known, and it will suffice to recapitulate that the industry is divided into two groups which usually work under separate management and with separate tool rooms and foundries. A "gravity" die-casting is produced by pouring the molten metal into a cast-iron or steel die which has usually been produced at quite low cost. The more elaborate "pressure" die-casting aims at being semi-automatic in its high-speed production. The mould and cores are generally made of heat-treated alloy steel and the cores and ejectors, which remove the finished casting, are mounted as part of the die and operated by rack and pinion mechanism. The precisely made pressure die is mounted on a die-casting machine and the alloy in a liquid or plastic condition is squirted into the mould under the action of high pressure.

Pressure Die-Casting Machines

There are very many types of die-casting machines in use, and the working pressure varies with the size and make of the die-casting plant. For casting the low melting-point tin-base and lead-base alloys, hand-operated "pull-bar" machines working at less than 100 lbs. per sq. in. produce excellent results, while for the zinc-base alloys melting at about 400 deg. C. a higher pressure should be used—it is generally found that such die-castings produced on hand-operated machines have porosity internally. Several well-known air- and plunger-operated die-casting machines specially intended for zinc-base work have working pressures ranging between 400 and 1,500 lbs. per sq. in. For aluminium-base alloys and yellow metals it is becoming evident that still higher pressures are advantageous, although aluminium die-castings can be produced on medium-pressure machines providing the rate of production is not speeded up to high. The "high-pressure" die-casting machines working on a hydraulically-operated plunger principle and using pressures of about 7,000 lbs. per sq. in. yield excellent results for die-casting high melting point alloys. Fig. 1 shows such a machine producing the main body of a well-known domestic wringer.

Scope of Die-Casting

In a discussion of the relationship between foundry casting and die-casting it may be interesting to see what the process can and cannot do. Even the simpler gravity die-casting usually does not become economical until amounts greater than 500 are involved, and the pressure die-casting process with its more expensive tooling and much more lengthy time of setting up, rarely shows economy until lots of 5,000 or more are to be considered. Die-casting is principally devoted to the utilisation of non-ferrous alloys of medium melting points. Probably nine-tenths of die-casting work in this country is made up of the aluminium-base and the zinc-base alloys. The yellow metals, 60/40 brass, aluminium bronze and certain special brasses can all be gravity die-cast, and 60/40 brass can in special cases be pressure cast with success.

Alloys melting at temperatures above 1,000 deg. C. are not, so far, commercially die-castable, mainly because the continued impingement of liquid metal on the steel die causes scouring of the mould face, so that after a small number of casts the surface appearance and the accuracy of the die-casting become so deteriorated that a foundry casting would probably have done the job better. Metals and alloys which are hot-short are not usually die-cast, for the powerful constraint of the features of the die on the rapidly chilled metal is such that an alloy which is weak near its freezing point will develop cooling cracks.

[*Photo. courtesy of Fry's Diecastings, Limited.*

FIG. 1.—PRESSURE DIE-CASTING MACHINE PRODUCING ALUMINIUM WRINGER BODIES.

Zinc-Base Alloy Die-Castings

Readers will probably know that for many years cast iron has been chill-cast in metal moulds for certain trades such as bedstead manufacturing, and this may be considered a form of gravity die-casting. Commercial die-casters, however, rarely manufacture die-castings in cast iron, for the temperature of the metal is so high that real accuracy cannot be maintained. Usually if any cast-iron part which previously had been a foundry product is dropped in favour of a die-casting, the modern zinc-base alloy is used. The composition generally employed contains 4.1 per cent. aluminium, 2.7 per cent. copper, a trace of magnesium, and balance of the purest available zinc.

The properties of this alloy in its pressure-cast state are superior to those of cast iron—for instance, the tensile strength is about 20 tons per sq. in. The alloy has a melting point of about 400 deg. C., so that its attack on the mould will be small; with a well-made tool as many as 500,000 or more shots can be produced from the one die with the accuracy maintained to plus or minus 0.002 in. per in. This die-life may be compared with the 50,000 shots usually obtained from a die producing aluminium-alloy pressure-castings, and about 7,000 shots averaged from the heat-treated tungsten steel moulds which must be employed in brass pressure-casting.

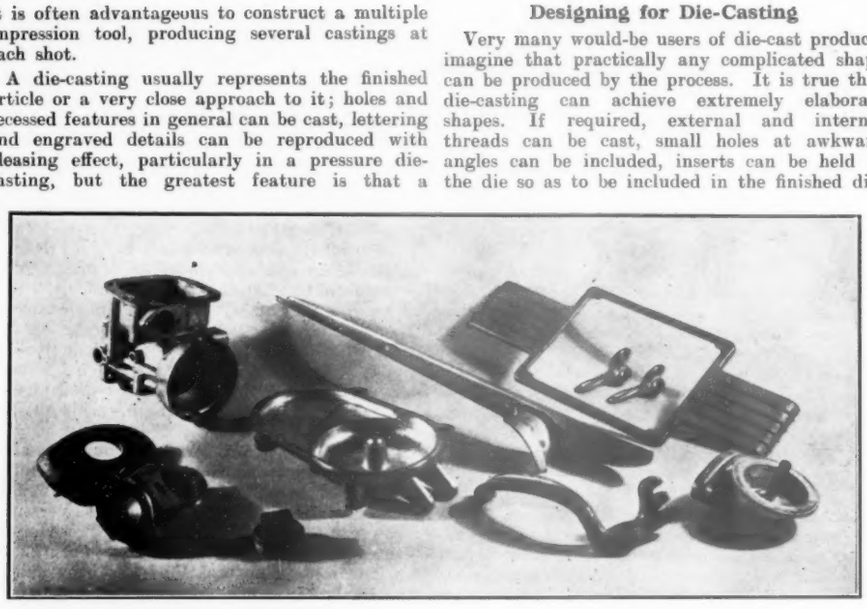
During recent years there have been many occasions when zinc-base alloy has been substituted for cast iron. Fig. 2 shows a group of typical pressure die-castings in zinc-alloy, and it is interesting that five of these die-castings were formerly produced in cast iron as foundry castings. It must be stressed that the raw material cost of zinc-base alloy is higher than that of cast iron—there are very few zinc-base die-castings in use which cost less than 6d. per lb. Usually the zinc-base alloys are employed when special features are required—accuracy, elaboration, cleanness or rapid delivery.

Some Advantages of Die-Casting

The die-casting industry does offer several outstanding advantages that have brought about its wide application into practically every industry. Once the die has been made delivery is quick; a gravity mould will average about 200 shots per day and a pressure die about 1,000 shots. If large numbers of the order of 100,000 pressure die-castings are required, or if several components which are used in sets are needed,

it is often advantageous to construct a multiple impression tool, producing several castings at each shot.

A die-casting usually represents the finished article or a very close approach to it; holes and recessed features in general can be cast, lettering and engraved details can be reproduced with pleasing effect, particularly in a pressure die-casting, but the greatest feature is that a



[*Photo. courtesy of Fry's Diecastings, Limited.*

FIG. 2.—ZINC-BASE PRESSURE DIE-CASTINGS FOR MOTOR CARS, CYCLES, RADIO AND CASEMENT FITTINGS.

die-casting saves a user worry. If tapping operations or the drilling of very small holes have to be done, the die-casting will drop into the jig without trouble. In these days when there is such a shortage of skilled finishing labour the reduction of machining operations in the user's own works is a further incentive to the use of die-castings.

Designing for Die-Casting

Very many would-be users of die-cast products imagine that practically any complicated shape can be produced by the process. It is true that die-casting can achieve extremely elaborate shapes. If required, external and internal threads can be cast, small holes at awkward angles can be included, inserts can be held in the die so as to be included in the finished die-casting and undercut designs can be produced. It is, however, a fascinating feature of modern die-casting application that practically every difficult proposition can be judiciously redesigned so as to make it suitable and take advantage of the unique features of this method of production. An article which is carefully designed will be cheaper and stronger, and will ensure a longer die-life than a part which has been adopted without reference to the needs of the process. For instance, a die-casting in which a thin section merges abruptly into a thick one will most likely be porous and weak at the junction, particularly if the metal has been run from the thin section into the larger one.

Future Possibilities

Die-casting is rapidly becoming an industry of major importance, and it is interesting to try to visualise its future. Probably the only changes that will come to gravity die-casting are improvements in technique, die steels and the alloys available. Any trend towards mechanisation of the gravity process (*e.g.*, mechanical opening and closing of the die and operation of cores) would mean that the expense of tooling would be so much increased that the fundamental advantage of low initial cost would be invalidated.

It is from the pressure die-casting process that the author anticipates more spectacular developments. Here again one must not look for excessive elaboration in the articles which are die-cast, but rather for improvement in all methods which lead to sustained accuracy in an improved product at reduced cost. Such factors would include greater co-operation between user and die-caster, better die steels, wider experience of die design, faster-operating machines, special plant for producing large die-castings, and the reduction of handling and hand-trimming operations. These improvements, however, would be valueless if quantities of only a few thousand were contemplated. Progress can only take place if even bigger quantities than are used at present are undertaken; only if the consumer can budget for his requirements over longer periods will the full advantages of this modern process be realised.

The Refractories Industry

By W. J. REES, M.Sc.Tech., F.I.C. (President, The Refractories Association)

THE year 1937 has been one of great demand for refractories of all types, and plants have been fully occupied. The very large expenditure which the industry has made on the modernisation and extension of producing units has been more than justified, and has enabled it to deliver to time to its busy consumers. The present productive capacity is such that further extensions of any magnitude are unlikely, but re-conditioning of older units will proceed actively during the present year.

Fortuitous methods of grinding, mixing, and tempering have been replaced by special types of crushing, grinding, and mixing plant which enable exact control to be exercised and secure absolute uniformity. Mechanised methods of moulding the various products have almost completely displaced the old laborious, and at times uncertain, hand methods, except for large and complex shapes; and even for these pneumatic rammers are in use to consolidate the material into the mould.

Technological Developments

Academic investigations have pointed the way to the design of drying rooms, humidity and tunnel driers which are much more efficient and reliable than the old drying floors and stoves. The application of these better drying processes has almost eliminated wastage in this stage of production, and in many cases it has been found possible to utilise surplus heat from the kilns which was formerly dissipated into the air.

The intermittent kilns which it is still desirable to use for burning some of the types of refractories have been increased in capacity, and their thermal efficiency has been greatly improved. In this latter respect, the refractories industry has been one of the largest consumers of its own medicine for preventing heat losses; and the continuously increasing production and use of insulating firebricks has been one of the features of the past year.

MR. W. J. REES.

For many refractories, and especially for those of fireclay, the intermittent kiln is now practically obsolete, having been replaced by continuous kilns—frequently gas-fired—of either the chamber or tunnel type. In all the stages of production from raw material to finished product, rule-of-thumb has given way to scientific control, and scientific instruments such as the pyrometer and draft gauge are now commonplace. The lay-out of many of the plants has been improved so that efficient flow sheets can be employed; and, in addition, what is particularly important with to-day's outlook, the working conditions have been vastly improved.

New Technique Improves Quality

Among recent developments in the production of silica bricks is a technique which necessitates the use of a special screening and grading plant, followed by a powerful hydraulic press for moulding the bricks. The uniform structure and perfection of shape and finish which is thus produced are factors of major importance in promoting the durability of the bricks under the extreme conditions of service in modern furnaces.

Composite Refractories

Fundamental research led to the production of new types of composite refractories, the outstanding example being the chrome-magnesite brick. Until recently the failure of these bricks to withstand the stresses produced by rapid heating or cooling, and their tendency to crumble or "grow" under some conditions of use, were a

serious limitation to their application in steel-melting furnaces, but the application of intensive research has resulted during the past year in such great improvements in the properties of these bricks as almost entirely to remove these limitations, and the "all-basic" furnace has been brought definitely a stage nearer realisation. Incidentally, it has been shown by trials which have been made that these bricks are specially suitable for lining the hot zone of the rotary cement kiln, and they will efficiently replace the bricks formerly used for this purpose.

Basic Bricks now Available

Definite progress can be recorded in the production of stable basic bricks from dolomite. Many of the difficulties in stabilising dolomite, at the same time retaining its intrinsic basic character, have been overcome, and dolomite bricks are now being produced which are giving service in particular parts of electric and open-hearth furnaces at least equal to that given by bricks made from imported magnesite.

Monolithic Refractories

The production of refractories which are used in granular form for the building *in situ* of the hearth and portions of the lining of the open-hearth furnace, the cupola, the crucible furnace and the electric induction furnace, has shown an increase corresponding to that for refractories in brick form. Fundamental studies of grading and bonding have been applied in the production of these granular refractories, and marked progress has been made in the provision of durable lining mixtures for rotary melting furnaces, as well as for induction furnaces.

Heat Insulation

Reference has already been made to the production of firebricks of low thermal conductivity, the extended use of which has been stimulated not only by the increasing cost of fuel, but by the marked general increase in the efficiency of furnaces which are properly insulated. Insulating firebricks, with a conductivity approximately one-sixth that of a normal solid firebrick, which are volume stable at high temperatures, are now available in quantity. With a backing of bricks made from diatomaceous earth, these heat-insulating firebricks reduce almost to vanishing point the loss of heat by radiation from the external walls of furnaces. The low heat capacity of these light-weight firebricks is also of importance, as with intermittent furnaces their use reduces the time necessary to heat the furnace to working temperature.

Research

The British Refractories Research Association has had an active year, and its effective co-operation with the British Iron and Steel Federation is producing results of great practical importance to both makers and users of all types of refractories. The Iron and Steel Institute, the British Cast Iron Research Association and the Institute of British Foundrymen have also been active in the investigation of specialised aspects of the selection and use of refractories.

A development of importance in training in refractories technology is the provision by the University of Sheffield of post-graduate courses of advanced study and research which lead to the degrees of Master of Technical Science and Doctor of Philosophy. There is an extending field of employment for such adequately trained men, not only in technical control, management and research, but also on the sales side of the refractories industry.

The Foundry Equipment and Supplies Trade

By A. C. TURNER (President, The Foundry Trades' Equipment and Supplies Association)

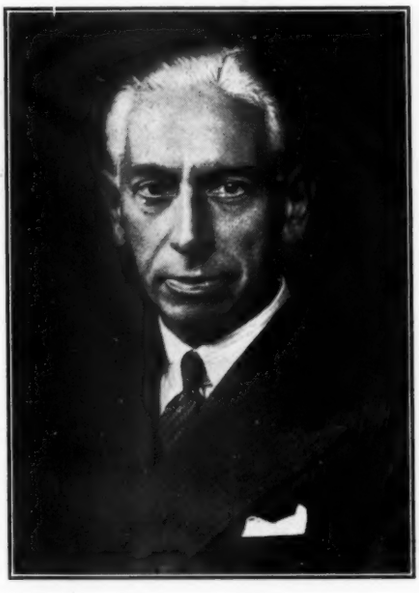
THE outstanding feature of last year was the holding of the Foundry Exhibition in connection with the biennial Shipping and Engineering Exhibition at Olympia. Whilst this was thoroughly representative of the "foundry supplies" side of the industry, it was inadequately supported by the equipment manufacturers. There were, however, about eight stands which did show modern shot-blast apparatus, core-blowing equipment and moulding machines. Since last September, the period of the Exhibition, this situation has been very closely examined, and there is a complete lack of unanimity as to an exhibition policy; but on one matter everybody is agreed—that at all costs the control as to where and when exhibitions should be staged must be retained by members of the industry.

Foundry Supplies and Small Machines

As many of the major commodities are dealt with by specialists elsewhere in this issue, it seems almost trite to reiterate that something approaching the boom conditions of 1920-21 have been repeated, but there was the distinction last year that the buying was of a more discriminate character than hitherto. This not only applies to materials but also to plant. Moreover, improved conditions have given an opportunity for the very smallest foundries to acquire a modicum of simple machines, such as mechanical riddles, hand-operated moulding machines, and modern crucible furnaces.

General Foundry Equipment

The year 1937 opened with overflowing order-books with the foundries pressing for deliveries, and up to May or June this condition persisted. At about this time, constantly rising prices and difficulties in connection with the coke and pig-iron markets seemed to exert a restraining influence on buyers, and conditions became distinctly quieter. By October, however, demand once more became pressing, and the close of the year saw the equipment manufacturers happy in the knowledge that the immediate prospects are at least healthy. This mid-summer lull was probably due to the panic buying of raw materials. For instance, one foundry which normally stocked pig-iron, scrap and coke to the value of about £2,000, augmented this figure to a level of about £9,000. Yet, despite the lull referred to, most equipment houses have had a record year.



MR. A. C. TURNER.

There has been increased buying by the steel foundries, whilst Clydeside and the North-East Coast have probably bought more plant during 1937 than for many years. South Wales, except for the steel foundries, has not made exceptional extensions. Amongst large-scale plant ordered is a roll-over pattern-draw machine with a turn-over plate 40 by 130 in., with a capacity of 10,000 lbs.

Sand preparing plant has been well in demand, and increased knowledge of the properties of sand and the necessity for close control have no doubt been responsible. Moreover, modern plant does not function at its best unless the moulding sand is controlled to give constant properties. The Sandslinger moulding machine is more than maintaining its popularity, and a major factor in this respect is the fact that the foundryman is becoming more mechanically-minded. Much information has been acquired as to the upkeep costs of the various units of mechanised plants.

A few years ago, the high-grade moulder was, to a limited extent, antagonistic to the use of moulding machines and Sandslingers. Nowadays, it can be authoritatively stated that the high-grade craftsman, when his machine is down for repairs, strenuously objects to hand-ramming large quantities of sand. Mass-production foundries do demand very large quantities of sand to be rammed, and Sandslingers capable of ramming 20 cwts. per minute are now being discussed.

New Equipment

Whilst there has been a general improvement in the design in all types of foundry equipment, especially in the direction of strengthening components liable to cause breakdowns, there have not been any really novel machines placed on the market, though a new type of sand mill should appear later this year.

A factor of some importance is a new service given by some firms to interlock heating and melting systems. For instance, one firm making oil burners pipes the whole foundry for such duties as melting, drying cores, ladles, sharp sand and the like. Others will effect a similar service for gas. Another new notion is the packing of turnings with soda ash to render them in a form eminently suited for charging into the furnace, whilst concurrently having a beneficial effect on the resultant metal. From Italy comes news of a modified type of sand-preparing plant, a description of which was given to the Paris Foundry Congress, and from Russia a process is reported to be in course of development for the production of "malleable" sheets made by introducing liquid cast iron direct into a pair of rolls. A similar process is in operation in America for the production of aluminium strip.

The Future

It is safe to say that the output of foundry machinery last year was about 75 per cent. higher than in 1936, and the consensus of opinion amongst manufacturers is that during this year the same level will at least be maintained. In

(*Concluded on page* 42.)

The Motor-Vehicle Foundry Industry

By G. W. BROWN (Foundry Superintendent, Austin Motor Company)

IT is a *sine qua non* that the motor-vehicle foundries are in the vanguard of foundry progress, and though the author has confined his review to the Austin plant, his remarks can be taken as being typical of the progress registered throughout the whole of this particular section of the foundry industry.

The year 1937 has been one of activity and progress for the motor-vehicle foundry, and still the endeavour for improvement continues more than ever. The foundry with which the author is associated has a great advantage in having directors and a controlling management who are insistent in their efforts for quality and are prepared to meet the necessary outlay to achieve it, and on a quantity-production basis.

It is well known that the mechanisation of motor-vehicle foundries was pioneer work, and was carried out when executives with experience of these layouts were few. Difficult times had to be faced, but optimistic confidence prevailed and further developments continue.

Trend of Foundry Mechanisation

Only those who do not wish to face the facts take up an attitude adverse to this development. Most United Kingdom foundries are interested in mechanical development and already great strides have been made, and the trend no doubt cannot now be arrested. Gone are the days when to talk of mechanisation implied only the whole cycle of operations, and now foundrymen generally understand that mechanisation means only the using of mechanical means where and when they can be best applied.

In addition, it is putting foundry practice in a mechanical language which encourages other works' executives to take a detailed interest in foundry work, and if this interest is dealt with in the spirit of co-operation the foundry will profit to a high degree.

Mechanisation, in its full sense, is, of course, best applied when repetition work is carried on, and the larger the quantities the better are the possibilities of application. This is what is understood as mass-production, but this can also be applied as production for the masses, and the manufacture of details in small quantities can in no way compete in price or quality with those made in the mass, where supervision and equipment are divided and subdivided as might be expressed *ad infinitum*.

The full significance of the following statement will be clear to all, especially direct foundry executives. It is that in an area of 760 sq. yards in the Austin foundry moulds are made, cast and knocked out to create an amount of 150 to 170 tons of cylinder blocks and heads per week.

The past year has seen the installation of a Bagshawe pendulum conveyor, being used at present on brake drums, the moulds being made on a battery of Nichols machines. The conveyor has an approximate length of 190 ft., and is composed of 81 plates of 38 in. by 24 in. The sand is supplied to the machines by the overhead belt system, and all overflow from the moulding machines is returned by an underground belt. The sand system on this plant has one of the Morris horizontal type of mixers, which is comparatively new to this country, the chief feature being a continuous feed with a rubbing action most suitable for synthetic sands. This plant produces approximately 2,000 drums per day.

To deal with the cleaning of these drums, two Wizard machines or airless-type shot throwers have been installed. Most readers will be familiar with the projecting or slinging action of these machines, and the consequent dispensing of compressor plants, and it is evident that this action, which can perhaps be embodied in many different ways, should have a progressive future.

Progress has been made in core blowing. Experiments and developments are constantly being pursued both in the foundries and in works of the equipment manufacturers. Great progress has been made throughout the trade in the application of these methods, but in the opinion of the writer they are still only in their infancy and will make tremendous strides in the future. The system of projecting the sand by air is not, in his opinion, the final method, and as the foundry executive gets more accustomed to demanding and making equipment necessary for these methods, progress will speed up accordingly. It is really similar to the methods of pressure die-casting except with the medium of sand instead of metal.

MR. G. W. BROWN.

Last year the Austin Company installed an automatic cupola-charging plant which has given great satisfaction, especially to the charging squad. The material bins are external to the main buildings, and the bogey carrying the skips passes under the railway siding alongside the main building, and the operators charging the skips are working in a covered building with all material at hand and little or no laborious work is entailed.

In addition to this plant, and for its better service, a platform built of ferro-concrete is being erected. It has a height of 16 ft., and is supported by 73 columns 15 in. square, and has a total area of 7,879 sq. ft., giving a storage capacity of approximately 6,000 tons. Two lines of railway sidings pass under this platform, and the remainder of the space below will be used for the storage of cupola coke and ganister. The chief feature of this, as will be noticed, is that both are under cover. Mention might also here be made that one of the B.T.-H. Volumetric control units has been installed for controlling the air for the cupola, under which system the volume is kept constant independent of the varying pressure.

The foundry is surrounded by buildings, roads and railway sidings, and therefore extensions generally have to be made vertically except for the floor extension being made at present. This, however, is to have a second floor to be used for the fettling section. The extension will consist of two floors, each 156 ft. by 50 ft., or an area of 7,800 sq. ft. The ground floor will consist of storage for coal-dust, plumbago, colloidal clays, etc., and moulding boxes, and workshop for foundry millwrights, electricians and pipefitters.

Interest will no doubt be aroused to find that such importance is given to the storage of moulding boxes, but when it is considered that the joint faces of these boxes must be kept flat—for which purpose a vertical grinding machine, at a cost of from £600 to £700, has been installed—and that the bushes are " tool room " made and hardened and ground, it is clear that a moulding box is considered as vital as any part of the equipment. This is an outstanding instance of the attention paid to detail by the motor-vehicle foundry.

The second floor, as already stated, will be used as a fettling section, complete with shot-blast cabinets and airless shot slinger machines. The cylinder blocks and large castings will be taken to the floor by a conveyor, serving at the same time as a cooling medium, while the small castings will be sent up an escalator. After cleaning, all the castings will be delivered to the machine shops by gravity roller conveyors. The space released by the removal of the existing fettling section will be utilised by the erection of another conveyor, in preparation of which a batch of small British moulding machines has been installed and is being worked under temporary conditions.

Plans are also well advanced for a sand reclaiming system, and it is hoped that before the end of the present year this plant will be installed.

What has been stated deals chiefly with the cast-iron section, which is, of course, the major portion of these foundries, but the steel-casting section also plays a large part in the foundry's activities, and the research engineers of the company keep the executives busy in their developments of materials and designs.

Judging by the daily stream of visitors the foundry can claim to be a place of interest, and scientific and technical societies would appear to consider it high in their lists for visitation. The directors and management appear only too pleased to welcome visitors and no attempt is made of any " hush hush " policy.

As this JOURNAL is the recognised mouthpiece of the Institute of British Foundrymen, it will perhaps be of interest to state that twenty of the foundry executives and workers are members of the Institute of British Foundrymen, Lord Austin having been elected an Honorary Member at the Annual Conference last year.

The foundryman has a host of people to satisfy and is, on the whole, at his best when kept busy endeavouring to do so, and the writer, on behalf of his colleagues and of foundrymen generally, will end this brief review with the well-known phrase:

" 'Tis not in mortals to command success,
But we'll do more, deserve it."

Joshua Bigwood & Son, Limited

The statutory meeting of Joshua Bigwood & Son, Limited, was held at Wolverhampton on December 30. MR. W. J. MERIFIELD (chairman) said that the new foundry was now in full working order, and production was increasing each week. Particular attention was being paid to the production of the Unicalor automatic stoker, the rights for which had been acquired by the company.

The Non-Ferrous Metal Markets in 1937

A YEAR OF WIDE FLUCTUATIONS

(By Our Metal Exchange Correspondent)

IF last year is not remembered for anything else it will remain in people's minds on account of the tremendous fluctuations in the quotations of commodities, as also for the erratic course pursued by stock markets on both sides of the Atlantic. Broadly speaking, 1937 may be divided into two halves for consideration, the first six months fulfilling the promise of a higher commodity price level shown during 1936; but the movement was marred by a speculative ramp culminating in March, when markets cracked and let loose a spate of liquidation. From July onwards, and particularly during August, uneasiness over events in the United States became apparent, for instead of staging an autumn recovery, the American business community turned bearish under the anxiety of discouraging legislation, and Wall Street developed into a cockpit for panic selling. Nothing like the collapse which ensued had been seen since 1929, and with inevitable repercussions in London, values of all securities on the Stock Exchange here suffered severely. Some recovery from the worst occurred before the year end, but the net reduction from the best was very great and the losses suffered were proportionate. To sum up, the public at large and the business communities had experienced a wonderful rise in values followed by a disastrous fall, the aftermath of which has followed us into the New Year.

COPPER

Copper opened the year in a very optimistic atmosphere, for the price trend was definitely upwards and the last day of 1936 saw the American domestic price advanced to 12 cents. In London, business on the Metal Exchange was very brisk, the turnover, for example, in the first week of the New Year being some 17,000 tons, for speculators were taking a hand in the belief that the American producers had abandoned their policy of price control and were preparing to let consumers take the bit between their teeth. January 4, the first market day in 1937, saw standard at £49 15s. and wire bars at £55, while about a week later another £3 had been added to the price. Then came something of a bombshell from the producers in the shape of an announcement that production would revert immediately to an unrestricted basis and the standard market was thrown into a state of no little confusion as speculators took fright and began to get out at any price. Consumers drew in their horns pending developments, but in spite of this the upward move continued, the domestic quotation in the States going up to 13 cents, while the opinion gained ground that the speculator was interpreting abandonment of restriction as a bullish factor. £54 6s. 3d. for standard and £59 10s. for wire bars were the highest points reached in January, but the market had come well under the thumb of the speculator and much higher prices were to follow.

Early in February electro was within 5s. of £60 and halfway through the month the American domestic price went up to 14 cents and in London standard stood at £58 with wire bars at £63 10s., while about a week later £69 10s. was reached. That was on a Friday and on the Saturday morning sellers were extremely reserved; followed by a not-easily-to-be-forgotten Monday, the first day of the B.I.F., when standard jumped to £70 and wire bars to £78, the American quotation going to 15 cents. Next day a loss of £6 10s. occurred, of which £3 10s. was recovered two days later. Activity in the standard market at this time was tremendous, the weekly turnover running above 30,000 tons, for speculators were buying heavily, and owing to the scarcity of early electro many consumers came to the Metal Exchange to secure cover.

London and New York began to react on each other, and a vicious circle was created which did infinite harm and was responsible for lifting values far beyond a reasonable level. At the end of February a backwardation in standard first made its appearance, and as the market moved upwards during the first half of March to reach its zenith, the premium for cash increased, standing eventually at more than £4. The top of the rise came for standard on March 11 at £78 5s. cash and £75 three months, while in electro the peak was touched four days later at £81. In America the top of the rise came at 17 cents delivered Valley, but there was very little copper sold at that figure and it did not last long.

By April the downward movement was well under way, for the realisation had come that values had been pushed up much too far, largely as a result of speculation encouraged by such events as the floating of the Defence Loan and reports of Government buying. A spate of liquidation occurred on 'Change as bull positions were closed, and there is no doubt that in addition to hedging by business interests bear selling helped to depress values. By the second half of April standard, 3 months, stood at £57 12s. 6d. with a premium of £4 for cash, while wire bars were £65; about a week later a further £3 had been lost. At the beginning of May the American domestic price dropped to 14 cents (at which level it stayed till nearly the end of September), and a period of comparative stability ensued during which standard dropped to £51 12s. 6d. and electro to £61 in mid-June. Thereafter a recovery occurred by the end of the month, at which time the backwardation in standard had all but disappeared, while in July we saw standard as high as £58 and wire bars at £65 10s.

Just after August Bank Holiday an upward movement culminated at £60 11s. 3d. for standard and £67 10s. for electro, many people believing that we were on the eve of an early autumn buying movement, but the rally was short-lived, for the American producers refused to be stampeded into raising their price above 14 cents, and August closed with the quotation £5 below the peak mentioned above. Looking back one can see that this was copper's last effort to stay the rot which began to set in, as it was realised that the long awaited improvement in U.S.A. business was hanging fire badly, and by September 30 three months standard in London stood at £47 6s. 3d., wire bars at £55, and there were sellers in the States at 12 cents delivered Valley.

The statistical position of the metal was, of course, deteriorating, for world stocks, particularly stocks in the United States, were increasing fairly rapidly, a development not unnatural with unrestricted production helped along by the spur of the fantastic prices ruling during the early part of the year. In October the long awaited announcement of a return to curtailment both in the U.S.A. and among the extra-American producers was made, but by this time sentiment was so bearish under the influence of a prolonged slump in Wall Street that the attempt to arrest the fall did little good, especially as it was known that the cut would not operate until December 1. On October 19 electro went below £50, and on November 8 the market grounded at £36 12s. 6d. for standard and £43 for wire bars, from which point there was a £5 recovery followed by another relapse to £43 10s. for wire bars. An improvement on Wall Street led to some recovery in London early in December.

TIN

The history of tin during the year just closed is one of ever fluctuating prices, the peak being reached as with copper in mid-March, the total range in the quotation covering £130. Speculation has been a good deal to the fore, other factors contributing to a somewhat disastrous year being a series of strikes in the United States, first in the automobile industry and then at the steel plants. This has obviously upset the tin market a good deal, for America is still by far the world's largest user of the metal, and any interference in that quarter cannot fail to have an adverse effect on values.

The year opened with the quotation at £231 5s., but January was quiet and £6 was lost by the end of the month. In the second half of February speculative activity in the tin market became apparent, and £250 was reached on February 23, after which matters moved rapidly, £256 being the value on March 5 and £277 on March 9. March 10 saw £301 10s. on the board, and the culmination of the rise came on March 15 at £311 10s., but then came a bombshell in the shape of an announcement that the quota was to be raised to 110 per cent., so that by March 22 the market had been sold down to £282 10s. A rally to £303 followed, but a fortnight later saw the quotation lower by £30. A few days later there was a further drop to £266, and on April 20 £250 was touched, the market finally grounding at the end of the month at £243.

There ensued a period of about two months when the quotation was moving up and down, the United States tinplate mills at this time running at 105 per cent. of capacity, while there was talk of the Pool being revived. Then came a few weeks when the trend was firmer as a result of better sentiment all the way round, the rise culminating early in August at £270 10s. Thereafter, as trouble developed in America, prices began to give way, and on October 1 the quotation was no better than £243, while less than a week later another £10 had been lost. Unexpected weakness began to show itself, and there was heavy selling which brought the price down to £206 15s., but by October 31 there had been a recovery to £223. Worse was to come, however, and November proved to be a very poor month, for tinplate operations in the States were down to 70 per cent. and towards the end of November the decline had reached such a pass that the quotation had gone as low as £181. The early days of December brought some recovery as the realisation grew that sentiment was definitely better and, moreover, there was the thought of a cut in output during the first quarter of 1938 to help matters.

LEAD

Lead made a flying start at the beginning of 1937, for when the New Year came in, the price of this metal stood fully £7 higher than spelter as a result of strongly sustained buying by consumers and speculators during the latter part of 1936. On January 4 the quotation was at £27 2s. 6d., and with a steady upward trend £30 was reached on February 19, at which point it was noticeable that consumers began to drop out somewhat. The enthusiasm of the speculators was, however, unbounded, and by the end of the month £31 12s. 6d. had been reached with a further sharp rise in March, culminating on March 11 at £36 7s. 6d. About this time senti-

ment in all the metals veered round, and only eleven days later the lead quotation had dropped by £5 10s. to £30 17s. 6d. on the realisation that production was running at a very high level, with a lot of secondary metal coming into sight. A brief recovery was followed by another decline, which took the quotation under that of spelter, and erratic markets followed, with bear covering braking the downward movement, which, however, persisted right up to the middle of June, when £21 was reached. At this point producers showed some reluctance to sell, and consumers who had been holding off began to buy in pretty good volume, as a result of which lead climbed up over £24 again during July and the early part of August.

Then came the beginning of the wave of depression in America, which, spreading to the London Metal Exchange, brought about heavy selling of lead in common with the other metals. At the end of August the price was £21 12s. 6d., while by September 20 £20 had been reached. There followed a brief recovery, but the month closed at £19 5s. There was good trade buying in evidence, the cable makers being well to the fore, but nothing seemed to stop the rot, and with the downward trend continuing throughout October, the bottom of the long fall was reached on November 8 at £15 12s. 6d., a figure considerably less than half the peak of £36 7s. 6d. touched in March. Ups and downs have followed, and there has been talk of producers getting together in an attempt to steady the quotation by reducing output, but nothing seems to have come of it. During the year an innovation, which came into force on July 1, was the changing over to the system of quoting buyers' and sellers' prices in the official daily list of values.

SPELTER

At the beginning of last year spelter had one great recommendation, and that was its cheapness in relation to lead, a metal which it normally surpasses in value, but which at that time was quoted some £7 higher. Otherwise there was little to encourage buyers, for production was running at a high rate and stocks appeared to be accumulating. January saw an upward movement, mainly in sympathy with lead, but in February a dramatic change came over the situation when it began to be realised that high-grade metal was going to be scarce and dear. Premiums much in excess of normal were paid on the Continent and were also secured by merchants holding stocks in this country, while consumers, who at that time had work on their books for a long way ahead, began to buy as far forward as possible.

On February 22 the price reached £30 5s., having begun the year at just under £20 and being little more than 25s. higher at the end of January, so that in three weeks there was an advance of nearly £10. Rumours that the Government intended to lay in stocks of all metals were going the rounds, and since high-grade spelter was known to be of great importance in munitions manufacture there was a rush to buy from many directions.

The upward movement culminated in March, when, as the result of panic buying by consumers and speculators, the quotation in London touched £37 on March 11. Two days earlier at £35 8s. 9d. spelter had shot ahead of lead, a position which was maintained for about six weeks, with the exception of one market day, viz., March 22. The break came with dramatic suddenness, and looking back one can realise that the climb had been sadly overdone and spelter was fully due for a reaction. Probably Mr. Chamberlain's statement that rearmament was not primarily responsible for the rise in metal prices was a strong contributory cause of the change round, for a spate of liquidation set in on account of bulls who were expecting still higher levels, and as the price declined "stop loss" selling orders were uncovered.

Not unnaturally, manufacturers who had bought well ahead held aloof in the face of this acute weakness, and the collapse that followed was one of the most disastrous seen in metals for many a long day. By April 20 the quotation was down to £22 7s. 6d., 12s. 6d. below lead, but a brief rally followed which took the price up to £25 15s. again. This was probably bear covering for the most part, and April closed at £22 3s. 9d., after which, apart from a rise to £24 3s. 9d. on May 24, the downward trend was resumed until £19 was reached on June 15.

On July 1 the Metal Exchange altered the method of pricing to include quotations for buyers and sellers, and for a few weeks matters improved, as consumers, attracted by the relatively low price, bought to replenish their holdings which had been allowed to diminish while values were falling. By August 9 the quotation had climbed up to £26, which, as a matter of interest, was £2 over lead at that time, the position of the two metals being temporarily reversed again. The drying up of demand, however, coupled with the development of a distinctly adverse trend in the United States, exercised an unfavourable influence on all the London metal markets, and by the end of August spelter was down to £23 2s. 6d. September proved to be a poor month and finished up at £19 2s. 6d., October brought a further decline to £16 15s., while on November 8 the bottom of the fall was reached at £14 16s. 3d. From the top spelter had come down by over £22, a reduction in value of 60 per cent. during the year. Some talk of a renewal of the Zinc Cartel was heard in December, but the suggestion does not seem to have been taken very seriously, and nothing more has been heard of the matter.

The Foundry Equipment and Supplies Trade

(*Concluded from page* 39.)

recent years, that is, since the introduction of tariffs, capacity for production has been increased out of all recognition. Since this, three large new factories have come into being, whilst existing ones have been considerably extended; yet in more than one case there are prospects of nothing but overtime being worked for many months ahead. The cost of raw materials, steel sections, iron and steel castings is now at a higher level than last year, and higher prices for equipment have naturally become necessary.

Export Position

The export of United Kingdom foundry equipment is gradually improving. South Africa has been a good market in recent times and has every indication of remaining so. In the other Dominions, however, American and Continental competition has to be overcome. A welcome change is the fact that some of the smaller Continental countries, which have habitually ignored this country as a potential source of foundry equipment, are now seeking to place orders here. It is doubtful whether the industry is relatively as big as those of the other great manufacturing countries, but the very fact of its more recent creation ensures that its products are of modern design. One of the difficulties in exporting plant to foundries is the fact that the overseas proprietor objects to paying freight, insurance and customs duty on castings which he feels sure he can make himself. This is a mistaken policy, as divided responsibility is thereby created, and the next step—that is, manufacture by the foundry of its own plant—was until fairly recently a major factor in the tardiness of its industrial development.

Acknowledgements

The author desires very cordially to thank the various equipment houses for the very considerable help they have given him in the preparation of this article, for without their kind co-operation the task would have been virtually impossible.

Dates and Data

We wish very gratefully to acknowledge receipt of the following diaries and calendars.

Diaries

From British & Continental Traders, Limited, Lincoln House, High Holborn, London, W.C.1: a four day to the page pocket diary containing specially selected data for the foundry industry. From Frodair Iron & Steel Company, Limited, 5, Fenchurch Street, London, E.C.: a waistcoat pocket diary. From General Refractories, Limited, Genefax House, Sheffield, 10: a four day to the page pocket diary containing much specialised data. From J. Gray & Sons, Limited, 5, Victoria Street, London, S.W.1: a seven day to the page pocket diary containing data for the vitreous enamelling industry; as such it is unique, and in addition there is an inset pocket book with square-ruled pages. From the Staveley Coal & Iron Company, Limited, near Chesterfield: a four day to the page pocket diary of new design, as it includes a special pocket for a stamp book, whilst the leather binding is a note case; there is a wealth of technical data, both of the general and particular variety. From J. Stone & Company, Limited, Deptford: a very neat little waistcoat pocket diary. From Stewarts and Lloyds, Limited, of London, Glasgow and elsewhere: a four day to the page pocket diary, containing a well-selected range of technical and other data—even to the opening of the Glasgow Empire Exhibition. From Thomas & Clement, Limited, Llanelly: a two day to the page diary, which means that there is ample room to follow Mr. Pepys' example.

Calendars, etc.

From Ashwell & Nesbit, Limited, Barkby Lane, Leicester: a daily tear-off wall calendar carrying a particularly fine aerial view of the River Thames. From City Engineering Works, 1936 (Pty.), Limited, Pretoria West, a leather pocket wallet. From Harris & Pearson, Limited, Stourbridge: a monthly tear-off wall calendar carrying illustrations of various firebrick sections. From W. Hendra & Son, Townmead Iron Foundry, Beddington Lane, Croydon: a monthly tear-off wall calendar carrying a charming picture of a young girl, "Friend o' Mine." From Holman Brothers, Limited, Camborne: a monthly tear-off wall calendar carrying a coloured picture of Mounts Bay, Cornwall. From W. & J. F. Jones, Limited, Pendlebury Foundry, Pendlebury, near Manchester: a monthly tear-off wall calendar carrying an extremely pretty picture printed on silk entitled "For Me," by W. H. Margetson, R.I. From Mavor & Coulson, Limited, Bridgeton, Glasgow, S.E.: a monthly tear-off wall calendar, illustrated with a picture of Loch Awe. From Thomas Robinson & Son, Limited, Rochdale: a monthly tear-off wall calendar which commemorates the centenary of the establishment of the business in 1838; a picture of the original works is included as an inset to an aerial view of the present plant. From Smith & Fawcett, Horton Works, Lidget Lane, Bradford: a monthly tear-off wall calendar, each month carrying a fresh picture of the works or its products. From Spencer & Halstead, Limited, Bridge Works, Ossett, Yorks: a monthly tear-off wall calendar, decorated by a picture of a bathing belle of the brunette type. From Stewarts and Lloyds, Limited, of London and elsewhere: a white monthly desk calendar. From the United Nail & Foundry Company, Limited, St. John's, Newfoundland: a Christmas card. From Wright & Company, 81, Clarence Street, Sydney, New South Wales: a monthly tear-off wall calendar, each page carrying a picture dealing with the production of nickel and its alloys.

In reiterating our thanks, especially to overseas readers, we wish to reciprocate the good wishes contained in many greeting cards received from United Kingdom readers.

The Future of the British Cast Iron Research Association

By The Rt. Hon. the EARL OF DUDLEY, M.C., D.L. (President)

AT the Annual Luncheon of the Association held in London in November last, I made, on behalf of the Council, an appeal to the industry, and particularly to members of the Association, to make provision for its future housing and equipment. In a necessarily brief statement I was unable to outline as fully as was desirable the considerations which have led the Council to put forward this scheme, and I propose to take advantage of this present opportunity to do so.

History

The British Cast Iron Research Association was founded as one of a group of similar bodies for a number of British industries under a scheme put forward by H.M. Government, after the Great War, to enable British industries to repair certain technical deficiencies which war conditions had revealed. A special department was set up, the Department of Scientific and Industrial Research, for the purpose of administering the scheme, and the Department is continuously advised by a group of eminent scientists who constitute the Advisory Council, of which the late Lord Rutherford was Chairman. The growth of the Department of Scientific and Industrial Research has been remarkable, for in addition to its relations with the research associations, it now administers on behalf of the Government the national laboratories, of which the National Physical Laboratory, the Fuel Research Station and the Geological Survey and Museum are perhaps the best known.

Less than one-fifth of the net expenditure of the D.S.I.R. goes to the whole of the research associations. Over a score of these bodies have been formed since 1918, the British Cast Iron Research Association being fourteenth in order of formation in 1921. These associations receive, under certain clearly defined conditions, financial assistance or grant from the D.S.I.R., the amount received depending on the actual subscription income received from each particular industry. The greater the industrial contribution, the greater is the grant, which is given to encourage firms to co-operate in applying science to their industry.

As in the case of a number of research associations, the early years of the B.C.I.R.A. were experimental in character and devoted to finding out how it could best serve the industry and to establishing the necessary organisation to accomplish this. Judging by annual expenditure, the B.C.I.R.A. progressed from small beginnings until it reached sixth place in the list of such bodies in existence, being exceeded in size by the great textile associations and those relating to the electrical and non-ferrous industries. Fig. 1 gives the growth in industrial income and total income, to which further reference will be made below. More recently, the growth of the work carried out by the Iron and Steel Industrial Research Council, which began in 1929 and with which the B.C.I.R.A. acts in close co-operation, has naturally exceeded in volume that of the B.C.I.R.A. itself.

While the former body is concerned, along with many other things, with steel castings, and the British Non-Ferrous Metals Research Association with wrought metals as well as non-ferrous castings, the B.C.I.R.A. is the only research association in the metallurgical industries exclusively concerned with founding. Bearing in mind that a number of research associations are sponsored and supported by powerful trade associations, the position of the B.C.I.R.A., which depends almost entirely on voluntary contributions from individual firms, is very creditable. At the same time, while the interests of ironfounders divide them over a number of trade associations representing various groups in the industry, arrangements whereby the Association and its resources could be placed at the disposal of the various trade associations, when required, in an advisory capacity, would be mutually beneficial. It is impossible to over-emphasise the essentially co-operative nature of the Association.

Scope

It may be mentioned that the most cordial relations have existed for many years between the Association and the Department of Scientific and Industrial Research, as with the various

THE RT. HON. THE EARL OF DUDLEY.

Government laboratories, departments and other research associations. The constitution of the Association is very comprehensive and it exists to promote the technical advancement of the "cast iron trade or industry and other trades or industries allied therewith or accessory thereto" and also "in connection with any trade or industry using grey or malleable iron castings." It has power to promote both discoveries and inventions in this field and to print and circulate books, Papers and other material bearing on these. It has power to receive and administer moneys, to establish branches and to carry out any form of scientific and educational work within its province.

The Association is incorporated as a company, limited by guarantee. The large bulk of its industrial income is derived from the annual subscriptions of member-firms and it is primarily intended as an Association of firms engaged wholly or in part in the manufacture of cast iron in all its forms—white iron, chilled iron, grey cast iron, malleable cast iron, in both light and heavy castings, and pig and refined iron. It is essential that member-firms be British, that is to say, over one-half of the capital of the undertaking must be in British hands. Subject to this proviso, the Council welcomes eligible members not only from this country, but from overseas, and has a number of members in Australia, New Zealand, India, South Africa and Canada. Foreign corporations in Great Britain, and employing British labour, but who do not comply with the above-mentioned condition, may be elected members by the Council, subject to the consent of the Board of Trade. The Association is an entirely self-governing body and the Council has complete discretion.

Membership Subscriptions and Services

The subscription for ordinary members depends upon the size of the foundry. Works having a weekly foundry payroll of 50 to 250 men contribute twenty-five guineas per annum. The labour figure includes all grades of labour on the weekly foundry payroll, other than patternmakers, clerks, and engineering hands. Foundries employing less than 50 pay fifteen guineas per annum, and in excess of a payroll of 250 the subscription rises in steps of twenty-five guineas for each additional 250, up to a maximum of one hundred guineas per annum for firms employing over 750 men. These subscriptions are payable in advance half-yearly, and are treated by the Inland Revenue authorities as business expenses from the point of view of income tax.

The Association is not required to pay income tax on subscriptions received, and operates as a non-profit-making body. These considerations, together with the fact that the Government grant is absolutely conditional upon the annual subscription income reaching a figure stipulated by the D.S.I.R., explains why the Association is compelled to seek its income regularly in annual subscriptions, rather than payment for individual pieces of work carried out. The published accounts show that over 80 per cent. of the total running expenditure is expended for the direct benefit of the industry in research and development, the remainder comprising administrative costs, rent of premises and other accommodation charges.

The services rendered to members may be briefly summarised. An active research programme is continuously maintained, and confidential research reports are issued to member firms as and when the work reaches completion. The subjects chosen are of specific interest to the industry, and in addition exploratory work is carried out. During the past five years, research reports issued in print and typescript have averaged twenty per annum. The research programme is dealt with by the Research Department, the largest in the Association.

The reports are issued to ordinary members for their information as confidential documents. A proportion of research reports are authorised by the Council for presentation to technical and scientific institutions at home and abroad, and these and other Papers by the staff and Papers by those external to the Association, but bearing closely on its work, are made available to members as non-confidential Information Bureau Reports. Of these, sixteen per annum have been published on an average for the past five years. Over five Papers per annum for each of the past five years have been presented by the staff to scientific bodies, in addition to lectures and talks not published fully.

The Development Department takes care of the second principal service, that of providing replies to inquiries raised and reports on problems submitted by members on any matter connected with the industry. This service is very popular, and during the past five years the number of inquiries dealt with has averaged between three and four per working day. These inquiries frequently involve laboratory estimations on samples, and, where necessary to the preparation of a satisfactory report, such tests are carried out without charge, but the Association does not normally undertake routine laboratory tests such as are ordinarily carried out by a works laboratory or an outside analyst. Problems often become minor investigations, and their treatment has a constant reaction on the

research programme, for they show where the industry is experiencing difficulties.

Inquiries refer to the raw materials of the foundry, mixtures, melting practice, sands and refractories, the design of castings, after-treatment, properties, foundry methods and equipment, finishing processes, etc. Where necessary, the staff arrange to visit members' works and visits from members are equally welcomed at headquarters. Members of the staff engaged in dealing with inquiries work on secrecy agreements and reports are prepared on each individual case on its merits and in the light of the information furnished. They are issued as confidential documents for the information of the member concerned.

The third service is that furnished by the Information Bureau in the form of reports on inquiries which can be answered from existing data. This service not only covers ordinary published information from technical literature, trade catalogues, patent specifications, etc., but

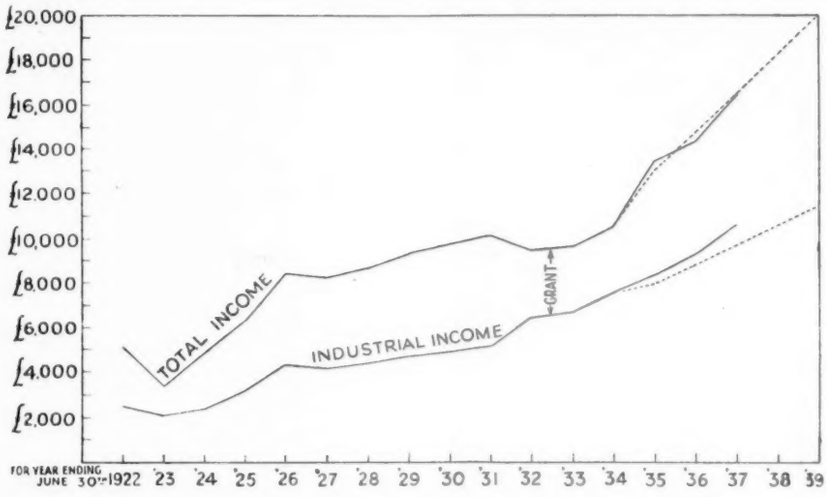


FIG. 1.—B.C.I.R.A. PROGRESS, 1921-1937.

(The dotted lines were shown in the 1934 Report to indicate the progress it was hoped to make during the present arrangement respecting grant from the D.S.I.R.)

data arising from personal contacts which the staff of the Association have with other laboratories, institutions, etc., in this country and abroad.

Amongst other facilities offered, the Association is empowered to carry out investigations of specialised interest for members, the results to be held for their exclusive use, provided the cost involved is met, but suggestions from members with respect to investigations which may form part of the general programme are welcomed at any time. Representatives of members are received at headquarters laboratories to study special techniques or the methods adopted for testing and control, and may be of long or short duration, according to the purpose desired. In several cases representatives of members have been trained in the laboratories for periods up to two years' duration, and such a course can be arranged on a sandwich basis, periods in the laboratories alternating with periods in the member's works. From time to time visits have been organised to important foreign centres where visits to foundries of special interest can be arranged.

The Association has paid special attention to the importance of establishing and maintaining close contact with members, and the officers of member-firms are encouraged to facilitate this by arranging for their foundry managers, foremen, chemists, metallurgists, etc., to have direct access to the Association when needed. Furthermore, meetings have been held in many cities throughout the country, at which items of special interest are discussed. These culminated in the arrangement in 1933 of a Study Course, which was attended by members for three days to listen to talks by the staff, see demonstrations in the laboratories and melting shop, and pay visits to members' foundries where there were special features of foundry design, equipment, or operation to be seen. The third of these courses was held in November, 1937, at which nearly 150 members registered their attendance.

The Information Bureau is also responsible for the issue of the Bulletin, now circulated six times each year and containing news of the Association, technical articles and a comprehensive series of abstracts on foundry developments. These abstracts are taken from data collected from world-wide sources and it is believed that the B.C.I.R.A. Library now forms the most important collection of foundry literature in the world. It is in charge of a skilled librarian and additions are constantly being made. It has constant contact with other institutions at home and abroad.

During the year ended June, 1937, the library received 665 accessions and the total number of loans averaged between seven and eight per working day. A collection of lantern slides is also available for members' use. For the past five years an average of 14 translations per annum of important foreign Papers has been made available to members. Whether the reports furnished by the staff of the Association come from the Information Bureau, from the Research Department or from the Development Department, whether they involve knowledge or experience, or both, they are absolutely impartial, as the Association has no interest to serve beyond that of its members themselves.

While the bulk of the support is derived from ordinary full (or Class A) members, the co-operation of suppliers of foundry equipment and material, and of users of cast iron is welcomed by the Council and for these firms (who form Class B members) a nominal subscription of five guineas per annum is charged. Their representatives have voting rights and receive the services of the Association, other than the provision of confidential research reports, which are intended for those having foundries. Individuals may join as Associate (Class C) members at a subscription of 21s. per annum, also with limited privileges, and the main object of this grade is to provide contact between the Association and persons interested, until such time as their firms take out ordinary full membership, when the individual membership lapses.

Council and Committees

The Association is governed by a Council consisting of members elected at the Annual General Meeting, together with a few added representatives of H.M. Government, the Services and co-opted members. The Council's responsibilities are exercised through three main committees, the Research Committee, Publications Committee and Education Committee. The programme of research is drawn up and approved by the Research Committee and supervision of specific investigations is exercised by nine research sub-committees dealing respectively with grey iron, nickel and alloy cast iron, melting practice, sands and refractories, malleable cast iron, white and chilled iron, pig-iron, light castings and tests and specifications. Panels of these sub-committees are formed when need arises.

The work of the Development Department is also supervised by the Research Committee. The Publications Committee supervises the Information Bureau and Library and is responsible for the issue of the periodical Bulletin and of Bureau Reports, for Papers by the staff to technical institutions and for participation in exhibitions and conferences. The Education Committee considers and promotes educational developments in the industry, knowing the importance of a trained personnel in applying science. Perhaps its most important work has been to assist in the establishment in 1935 of the British Foundry School, a school for training men who have shown sufficient promise in foundry leadership to justify a year's full time training. The names of approximately two hundred representatives of members appear on the Association's committees.

Laboratories

The Research and Development Departments can draw on the services of a group of laboratories, staffed by specialists, where tests can be carried out. During the past five years the chemical laboratory has made for these two departments an annual average of 5,000 chemical estimations, and in the microscopic laboratory a similar average of 1,000 micro-examinations has been made, a proportion of which are permanently recorded photographically. The mechanical testing and sands laboratories have each averaged for a similar period about 2,000 tests per annum, the mechanical testing including tensile, transverse, impact, hardness, etc., the sands and refractories tests including strength, permeability, grain size, sintering temperature, etc. Test castings and bars are made in a small experimental foundry.

Some Results

THE FOUNDRY TRADE JOURNAL, in a leading article, recently expressed the view that perhaps the most important result of the work of the Association has been to raise the standard of the industry generally, and this, of course, is one of its most important objects. The metallurgical and practical foundry developments of the Association have been such as to win for it a reputation internationally, which brings to headquarters a steady stream of inquiries and visitors from the Dominions and other countries overseas. Among these developments may be mentioned the ferritic heat-resisting iron known under the trade name Silal, characterised by a high silicon content and fine graphite structure, together with the austenitic heat- and corrosion-resisting iron Nicrosilal, based essentially on Silal and containing additions of nickel and chromium.

More recently, work has been carried out on the heat-resisting properties of aluminium cast irons, the possibilities of which have been recognised for some time. Such a material is now in process of development under the name Cralfer. In one of its earliest investigations, the Association confirmed the effects of superheating on graphite refinement and devised various methods of helping to procure graphite structures in an extremely finely divided form. These culminated some time ago in the now well-known process, patented by the Association, by which irons of practically any carbon content, provided they are not kishy, can be converted to a fine graphite structure by the incorporation of a small amount

of titanium, followed by treatment with carbon dioxide. The application of this process to commercial practice is now being undertaken.

Among other investigations may be mentioned those on the influence of manganese on cast iron in relation to sulphur, and on the effects of alloy additions, including nickel, copper and molybdenum. The present programme includes a complete survey of high-duty cast irons, including those requiring heat-treatment and malleablisation, together with an investigation on shrinkage and contraction. Mention may also be made of work done on establishing standards for testing, and two reports have been made generally available to the industry in the form of special publications, "Recommended Methods for Sampling and Analysis of Cast Ferrous Metals and Alloys" and "Recommended Methods for Testing and Control of Foundry Moulding Sands." From the point of view of melting practice, the Association's balanced blast cupola has achieved a considerable measure of success. In seven years, 175 installations have been made or are under construction, with an aggregate hourly capacity in excess of 1,200 tons. Fifty of these installations have been or are being made overseas.

Fig. 2 gives the progress of the furnace with respect to total hourly output and number installed over the period in question. The bulk of the early installations, being made during a period of depression, were conversions of existing cupolas, but recently the proportion of new furnaces has increased. The Association regards the high metal temperature and uniformity of running as the most important advantages of the furnace, but apart from these, the fuel saving effected by the installations made and used in Great Britain is conservatively estimated at £25,000 per annum, *i.e.*, about three times the total annual subscription income from the industry. It has been applied to all types of service for which a cupola is used, and it is roughly estimated that about one-fifth to one-fourth of the cast iron now melted in Great Britain is melted in this type.

Patent Policy

In order to preserve the interests of members, the Council follows the policy of filing patent specifications for developments made by the Association which lend themselves to this method of treatment. The Council determines the conditions under which patents are used by members, according to the merits of each case, but apart from a nominal royalty on output of the Silal and Nicrosilal irons, and a single fee charged for the design of the cupola, the tendency has been to regard the members' ordinary subscription as inclusive. The Association holds a number of British patents, in connection with which many foreign patents are also held.

A number of members are licensed to make the above-mentioned heat-resisting irons. The following firms are licensed by the Association to make or convert cupolas to the balanced blast system in the United Kingdom: Alldays & Onions, Limited, Birmingham; Constructional Engineering Company, Limited, Birmingham; George Green & Company, Keighley; The Horsehay Company, Limited, Wellington, Shropshire; J. W. Jackman & Company, Limited, Manchester, and Pneulec, Limited, Smethwick.

In Australia the business is dealt with by T. Main & Sons Proprietary, Limited, Melbourne, in Czecho-Slovakia and Eastern Europe by Metalinventio, Prague, and in the U.S.A. by the McWane Cast Iron Pipe Company, of Birmingham, Alabama.

The Future

The history and development of the Association to date have been outlined, partly because the Council has every right to be proud of the achievement recorded, but in part to underline the fact that it has been reached in the teeth of very considerable difficulties. These have arisen in the main through lack of suitable equipment and accommodation, which in turn has arisen from lack of capital resources. The original constitution of the research associations provided for a means of raising income to be expended on research and development, but did not provide any means whereby this work could be carried out, except on the initiative of the Associations and their members. In the first place, therefore, most Associations arranged to have their work done in various university and national laboratories, but in the majority of cases they have now built their own laboratories, and the advantages of this have been pronounced.

The British Cast Iron Research Association rented a small laboratory for the first time in 1924, and in 1926 was able to centralise the office and laboratories in Birmingham at St. Paul's Square, occupying an area of 2,500 square feet. In 1932 the late Lord Rutherford opened extensions. As need and opportunity have arisen, this has been further extended until an area of 10,000 square feet of an essentially factory type of building is now occupied by a total staff approaching forty. Incidentally, of fifteen members of the scientific staff who have now left the Association, no less than twelve are engaged in the industry, some in highly responsible positions, mainly with members. The remainder are in national laboratories or in educational work.

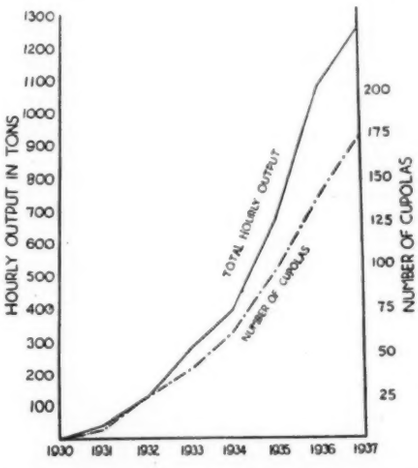


FIG. 2.—BALANCED BLAST CUPOLAS INSTALLED AND UNDER CONSTRUCTION, IN JUNE OF EACH YEAR, 1930 to 1937.

Reference should also be made to the fact that in 1926 the Falkirk Technical Institute, which had been started by a group of light castings manufacturers in the Falkirk area, joined with the Association, and since that date the Institute has been the Association's Scottish laboratory. It has been a great advantage in providing a base from which inquiries and problems could be dealt with, particularly in view of the high concentration of foundry work in Scotland and especially in the Falkirk area. The equipment necessary to the growth of the laboratories had to be provided out of income, and the present investment in equipment is approximately £7,000.

The staff of the Association is painfully aware that the equipment available represents an irreducible minimum, and that work in progress or projected is seriously handicapped by the lack of apparatus which should be available to a national body, and hence, through it, to members. Successive Presidents have commented both on the urgent necessity for additional equipment and on the economy with which the Association's operations are carried out.

Some months ago the Council decided in principle that the time was ripe to make an effort to repair the deficiency, and I outlined the scheme at the annual luncheon on November 4, 1937, which is given in the November, 1937, Bulletin. The Council desires to raise a sum of £30,000, and preferably £40,000, for equipment and housing, and for this scheme they have the support and sympathy of the Department of Scientific and Industrial Research.

The present grant scheme, under which the Association is working, provides that for an industrial income from annual subscriptions from the industry of £7,000, the D.S.I.R. contributes a grant of £5,000. In order further to encourage the support from industry, the Department is prepared to pay grant at the rate of £1 for £1 on further industrial subscriptions up to a limit of £3,500. Fig. 1 shows the progress made. The dotted lines starting in 1934, when the present grant scheme was put into operation, indicate the way in which the Council hoped the income would expand in order by 1939 to be taking the fullest advantage of the Government offer. It will be seen that the income closely follows expectation. It should be pointed out, however, that the industrial income includes a proportion of income from various sources which for various reasons is not actually grant-earning.

Up to the limit of the present scheme, the D.S.I.R. has agreed to treat contributions to the equipment and accommodation scheme as grant-earning. Beyond that they cannot at present go, but there is every reason to believe that when a new grant scheme is considered for the five-year period beginning in 1939, provision will be made similarly to permit such contributions to be treated on a grant-earning basis. In order to give the maximum possible assistance to the Association within the limits of the powers conferred upon the Department by Parliament, the Department suggested that contributions should be spread by members over a period of five to seven years, and hence in my letter of appeal, circulated to members early in December, 1937, I suggested that donations should preferably be made on this basis. The letter itself is given below.

> At the Annual Luncheon on November 4, I was able to announce the scheme formulated by the Council for the future housing and equipment of the Association.
>
> The Council's aim is to provide equipment and apparatus necessary to carry out the work the Association has to do, and to house this in such a way that, in respect of technical resources, the industry will be in at least as good a position as our great industrial competitors abroad, and better able to meet competitive developments at home.
>
> The sum to be raised is £30,000, preferably £40,000, and the attached statement indicates the directions in which it will be used. The Council has decided to raise this sum by making direct application to members in this, the first general appeal to them since the Association's inception.
>
> Contributions may be made in the form of a single lump sum, or may preferably be spread over a period of years not exceeding seven. These payments, like ordinary subscriptions, will be regarded by the Revenue Authorities as a business expense for income tax purposes. The Department of Scientific and Industrial Research has indicated that, subject to the observance of certain formalities, contributions will be treated as grant-earning, which means that up to one-half of the sum required may be provided by the Department. For the information and guidance of members the amount required can be obtained if members contribute (either in a lump sum or spread over a period of years as given above), a sum equivalent to double their usual annual subscription and, of course, additional to it.
>
> I warmly commend this appeal and trust that your contribution may figure in the first list of acknowledgments. Fuller details are given in the attached reprint of speeches made at the Annual Luncheon on November 4.
>
> DUDLEY, *President.*

r2

It is estimated that if members contribute in this way a sum equivalent to double their annual subscriptions and, of course, additional to it, the end in view will be achieved.

The provision which experience has shown should be made is indicated in the scheme outlined below:—

General.—Offices, library and information bureau, conference and lecture room.

Experimental Foundry. — Experimental cupola, fitted to measure air supply, power supply, and to provide for gas analyses, etc. Oil-fired and coke-fired crucibles. Electric arc furnaces, 5 cwts. capacity. Electric induction furnaces, 2 lbs. and 5 cwts. capacity. Small oil-fired rotary furnace. Furnaces for annealing, heat-treatment, malleablising. Shot blast. Drying and core ovens, sand mill, boxes, patterns, etc. Stores.

Machine Shop.—Lathes, drilling machine, milling machine, surface grinder, hacksaw, grinding wheels.

Mechanical Testing Laboratory.—Testing machine for tensile, transverse, compression. Extensometers. Stress - strain recorder. Machines for testing hardness, wear, impact fatigue, damping capacity.

Microscopic Laboratory.—Polishing apparatus. Metallurgical microscopes and objectives. Copying camera. Dark room equipment. Equipment for technical colour photography and for the use of infra-red, ultra-violet and polarised light and oblique illumination.

Sands and Refractories Laboratory.—Apparatus for grain size estimation, shaker, sieves, elutriators. Apparatus for strength testing green and dry sands. Apparatus for permeability testing. Apparatus for testing hardness, moisture content, for drying and baking. Furnaces for determining sintering and melting points of refractories, and refractoriness under load.

Chemical Laboratory.—(*a*) Laboratory for estimations of carbon, silicon, phosphorus, manganese, sulphur, nickel, chromium, copper, molybdenum, vanadium, titanium, etc. (*b*) Small laboratory for investigating new analytical methods, where needed, micro-chemical methods, etc. (*c*) Laboratory for analyses of sands, refractories, clays, slags, fluxes, vitreous enamels, fuels, coal dusts, blackings, facings. (*d*) Small laboratory for separation and estimation of non-metallic inclusions and for gas analyses.

Physical Laboratory.—Dilatometers. Pyrometers, galvanometers, chronograph and furnace. Apparatus for thermal and electrical conductivity. Apparatus for spectographic and crystal analysis (X-rays). Apparatus for magnetic tests.

Enamels Laboratory.—Small enamelling furnace, spraying equipment, cradle. Apparatus for tests of opacity, reflectivity, adhesion, brittleness of enamels.

Finishes Laboratory.—Provision for work on other finishes, as required, galvanising, plating, rust-proofing, tinning, etc.

Welding Laboratory.—Apparatus for the experimental gas and electric welding of various types of cast iron for repair and jointing purposes.

Research Laboratories for specific investigations according to programme and not otherwise provided for.

I have included these two documents in this article for two reasons. In the first place, it is difficult to provide all the executive officers of a member-firm with copies of the appeal itself, or to include in the appeal the fuller information and data given above and of which they would naturally desire to take cognisance in considering the appeal. I also include it in order to draw the appeal to the attention of those directly in or concerned with the industry, but who may not be members of the Association, because I feel that there are firms, institutions and individuals who could discharge an obligation by making a contribution.

The Association is intended primarily for subscribing members, but it can scarcely fail, and, in fact, has not failed, to influence the industry as a whole. It is compelled, by virtue of its position, frequently to act in the interests of the industry as a whole and to maintain the prestige of the industry. Hence its existence must react to the advantage of all makers and all users of the materials in which we are interested, and it must be beneficial all round to have a scientific institution of the highest order, housed in an appropriate manner and equipped to provide both the data on which the industry must rely for its present practice, and to point the lines of development for the future.

I am conscious that this review is not a review of the immediate technical developments for the past year, but the circumstances of the moment have justified me in both looking a little further back and a little further forward, to ensure the future of an institution which has done so much to crystallise consciousness of itself, not only as an industry with an ancient and honourable past, but one also with a great and expanding future.

The Light Castings Industry

By J. M. PRIMROSE (Director, Grangemouth Iron Company, Limited)

WHILE it would be an exaggeration to say that 1937 was the "maddest" year in the history of the light castings industry, it can certainly be said that ironfounders gladly saw the end of one of the most topsy-turvy years in their experience. It began quietly with doubts about the increased volume of trade experienced in 1936 continuing, quickly to resolve itself into doubts about accepting further orders. About the middle of the year things began to stabilise themselves, and foundries settled down to what seemed in the ultimate to become quite a prosperous year.

This period did not, however, last many weeks before straws in the wind began to indicate another change. There were reductions in staffs in odd works, reports of stocks growing in others, and lack of new orders in several, despite the fact that most of the foundries were still working to more than capacity. These adverse signs began to become more general in November, and 1937 passed quietly as it began.

It is difficult to give any general review of the light castings industry owing to the complexity of the uses of cast iron, and it is therefore impossible to do other than pick out in detail some of the larger productions of the trade. Pride of place must be given to the raw materials of other industries, such as light engineering and textile machinery castings; and electric motor castings and the like.

Engineering Castings

These have bulked largely in foundry work during the year, and despite all difficulties it is thought the foundries have responded to the abnormal demands made on them. The foundries took some weeks to settle down in the early part of the year, but once in their stride engineers

MR. J. M. PRIMROSE.

as a whole had little cause to complain of output, although it cannot be said that quality was up to the usual high standard, as for the whole of the year ironfounders have been fighting for supplies of pig-iron, and in many cases during the January-June period only day-to-day supplies were procurable, sometimes necessitating a temporary shut-down for a day or so waiting on a fresh delivery. They had to take what was offered, outwardly grateful but inwardly cursing, as much of it could only come under that expressive Yorkshire word (using the dialect), "muck." Ironfounders, however, frankly admit that pig-iron producers at that period were doing their utmost with the inadequate raw materials at their command.

Electric Motor Castings

Despite many alterations in design and increased demand, founders catering for this class of work can be proud of the fact that most delays were not caused from the foundry side, supplies of castings practically always keeping ahead of other necessary materials.

Builders' Castings

A large section of the industry is engaged in the manufacture of goods for house building, and this trade can be easily classified under seven headings: baths, cookers, heating stoves, rainwater pipes, gutters, soil pipes and general castings.

Baths.—Output has been well maintained and works kept fully occupied. Makers, however, have been nearly driven "off their rocker" by the constant changes in the analysis of their iron causing irregular contractions and other defects, which made it practically impossible to produce a good enamelled surface without in many cases re-enamelling. It says much for the enamellers that their difficulties did not cause at least a partial shut-down.

Cookers. — The largest section, coal-burning cookers, comes under the heading of "combination" grates. A post-war demand for this type quickly supplanted most of the old types of

(*Concluded on page* 74.)

The Foundry Industry Month by Month

January

A PRICE REDUCTION of £20 a ton for nickel came into operation on the first day of the year.

A PARTY of Cape Town University students made a tour of Tyneside works.

THIRTY-TWO BLAST FURNACES were operating in the North-East area—an increase of six in a year.

TWENTY-FIVE THOUSAND sewing machines for shipment to the Far East provided overtime for Singer's Clydebank employees.

A PROMINENT MEMBER of the foundry supplies trade, Mr. F. E. L. Walker, head of the Rotherham firm, died suddenly. Another loss to the industry was the death of Mr. T. P. McNab, closely associated with the manufacture of foundry machinery, while from Germany was reported the death of Prof-Dr. Aulich, prominent research worker on sands.

THE CONSTITUTION of the council of newly-formed South African Branch of the Institute of British Foundrymen was announced, Mr. T. Nimmo Dewar becoming the first Branch-President.

NEARLY A HUNDRED new members were elected to the Institute of British Foundrymen at a Council meeting at Bradford.

AT THE Birmingham Branch Dinner the principal speaker was Lord Austin, who revealed that the first foundry of which he had control was in Melbourne, Australia, 45 years ago.

THE CRYSTAL PALACE disaster provided about 15,000 tons of scrap iron for remelting.

BELL-FOUNDRY EMPLOYEES at John Taylor's Loughborough works received a windfall of £50 from an American donor, in recognition of a carillon built by the firm for a university in the U.S.A.

February

A FUSION of interests between Davy Bros., of Sheffield, and the United Engineering & Foundry Company, of Pittsburgh, was announced, Davy Bros. henceforth being known as Davy & United Engineering Company, Limited.

EXPENDITURE of £3,500,000, to be spread over the next few years, for new plant at the Appleby Works of United Steel Companies, was announced.

THE NEW Factories Bill, strengthening and extending the existing legislation, was published.

THE STANTON IRONWORKS COMPANY offered to invest a capital sum of £10,000, in celebration of Coronation Day, for some object in the permanent interest of their employees, "preferably some object of general health service."

£3,000,000 WORTH OF ORDERS for a Turkish steelworks were received for allocation among eight British steelworks.

MR. WESLEY LAMBERT, C.B.E., Past-President of the Institute of British Foundrymen, was elected an honorary member of the Institute.

IT WAS REPORTED that the United States had received an inquiry for 100,000 tons of pig-iron from this country.

PATTERNMAKERS WERE GRANTED a wage increase of 2s. per week, raising the standard all-in rate to 66s. 6d. in England and 68s. 6d. in Scotland.

THE RT. HON. WINSTON CHURCHILL stressed the need for the national defence scheme at the annual banquet of the British Iron and Steel Federation.

STEELMAKERS AND SCRAP MERCHANTS arrived at an arrangement for the supply of all available scrap at economic prices, in an endeavour to relieve the scarcity of raw materials for steelmaking.

THE BRITISH INDUSTRIES FAIR was held in London and Birmingham.

AN 80-TON CAST-STEEL mill housing was despatched by the English Steel Corporation, from their Grimesthorpe Works, to a Coatbridge firm of steel rollers.

CROFTS (ENGINEERS), LIMITED, the well-known Bradford concern, celebrated its Jubilee.

March

A SCHEME of co-operation between the Iron and Steel Institute and the Institute of Metals, effective from January 1, was announced.

THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION, at its annual meeting in London, elected Mr. A. C. Turner as President, in succession to Mr. G T. Lunt.

THE FIRST annual report of the East Anglian Section of the Institute of British Foundrymen, which was established in March, 1936, was held at Ipswich. Membership stood at 44.

ONLY 1.96 PER CENT. of members of the Iron-founding Workers' Association were unemployed, according to the annual report.

BESSEMER GOLD MEDALS were awarded by the Iron and Steel Institute to Col. N. T. Belaiew of Paris and Mr. Aloyse Meyer of Luxemburg.

MR. FRED B. ERB, a prominent American foundryman, and Past-President of the A.F.A., who participated in the London International Conference in 1929, died.

A PARTY of 20 members of the London Branch of the Institute of British Foundrymen visited a number of representative foundries in Belgium. The hospitality of their Belgian friends made the tour a particularly delightful one.

THAT THE Combustion Makers' Association (Solid Fuel) had established a research department was announced by Lt.-Col. J. H. M. Greenly, the President, at the annual meeting.

MR. GEORGE BATTY, Sheffield University trained metallurgist, who went to America and became one of the best-known steelfoundry consultants, died in Pennsylvania.

THE BRITISH STEELWORK ASSOCIATION was wound up voluntarily, its assets being paid over to the British Constructional Steelwork Association for the use of that body's Propaganda Committee.

April

AN INTERNATIONAL AGREEMENT for communal scrap purchases and distribution was discussed in Venice.

THE L.P.T.B. decided against the undertaking of a tube-railway extension, owing to the fact that, with the increased price of steel, the cost of building a tube had risen from £750,000 to £1,000,000 a mile.

THE FORMATION was announced of the Joint Committee on Testing Materials, on which 22 technical institutions were represented.

MR. ACHILLE BRIZON was elected President of the French Foundry Technical Association, in succession to Mr. Maurice Werts.

THE BRITISH ACETYLENE ASSOCIATION held its annual meeting, presided over by Mr. L. J. Tibbenham, chairman of the East Anglian Section of the Institute of British Foundrymen. An inscribed gold watch was presented to Mr. V. A. Amodeo, in recognition of his services to the Association as secretary.

INCLUDED IN THE new members elected to the Institute of British Foundrymen were 35 attached to the newly-formed South African Branch.

THE ANNUAL MEETING of the Iron and Steel Institute was held in London. Sir H. C. H. Carpenter was succeeded by Mr. Alfred Hutchison as President. The Report of Council disclosed a membership at the end of 1936 of 2,243, an increase on the year of 328. The Minister of Labour (the Rt. Hon. Ernest Brown) was the principal guest at the annual dinner. Among the Papers presented at the technical sessions was one by Mr. J. E. Hurst dealing with the influence of silicon, phosphorus and manganese on nitrogen-hardening cast irons.

May

CORONATION DAY, May 12, was celebrated throughout the country. Many foundry employers granted a day's holiday with pay or special bonuses to their workpeople in commemoration of the event.

ABOUT 625,000 TONS of steel scrap were bought in America by the British Iron and Steel Corporation on behalf of the ten members of the international scrap arrangement.

PRICES OF THE main steel products were advanced on May 1, the new levels to operate until the end of the year.

THE CRUCIBLE STEELMAKERS' ASSOCIATION elected Mr. L. Chapman as their new President.

MR. P. M. BOOTH, an East Anglian foundry owner, and a member of the Institute of British Foundrymen, was created a knight in the list of Coronation Honours.

MR. G. B. R. TAVERNER, of British Pigirons, Limited, a popular figure in foundry circles, died suddenly.

THE BRITISH FOUNDRY SCHOOL issued its first annual report, in which the belief was expressed that "the results of the first year's working have amply justified the experiment." The number of students who enrolled for the first session was thirteen.

THE AMERICAN FOUNDRYMEN'S ASSOCIATION elected Mr. Hyman Bornstein as the new President at the 41st annual convention.

A PARTY of important American executives and bankers arrived in England to study research organisation in this country.

DR. J. W. MELLOR, President of The Institute of Vitreous Enamellers, was elected first President of the British Refractories Research Association.

THE MAYOR OF WARRINGTON opened the new foundry of the Warrington Light Castings Company by tapping the cupola and making the first casting.

THE CORBY STEELWORKS were visited by the Prime Minister of Turkey.

June

THE NATIONAL SAFETY FIRST ASSOCIATION elected Lord McGowan as President.

THE 34TH ANNUAL CONFERENCE of the Institute of British Foundrymen was held in Derby from June 8 to 11. The retiring President, Mr. H. Winterton, presided at the outset, later inducting his successor, Mr. C. W. Bigg, into the chair. Mr. J. Hepworth, J.P., M.P., and Mr. W. B. Lake, J.P., were elected Senior and Junior Vice-President respectively. A record membership—2,065—was disclosed by the annual report, which was a review of real progress in manifold directions. The Oliver Stubbs Gold Medal was awarded to Mr. P. A. Russell, and the E. J. Fox Gold Medal to Emeritus Prof. Thomas Turner, M.Sc. Lord Austin was elected an Honorary Member. One notable feature of the Conference was the fact that the Civic Welcome was given by a woman, the Mayor of Derby being Councillor Mrs. Petty, J.P. Following his induction, Mr. Bigg announced that his co-directors of Qualcast, Limited, wished to mark the occasion of his accession to the Presidential chair in a tangible manner, this taking the form of a gift of £500 to form the nucleus of an endowment fund for promoting the work of the Technical and Education Committees. Mr. Bigg's address reviewed some of the problems facing the industry in its efforts to secure recognition commensurate with its true importance. In a brilliant analysis he indicated the avenues along which progress would have to be made before the status of the foundry could become among the highest in industry. At the annual banquet the principal speakers included Mr. Alfred Hutchinson (President of the Iron and Steel Institute), the Mayor of Derby, Sir J. Arthur Aiton, Mr. W. R. Barclay (President of the Institute of Metals), and Mr. E. J. Fox. During the banquet a presentation to Mrs. Winterton, wife of the Immediate Past-President, was made by Mr. Bigg. As usual, a varied selection of technical Papers was presented for discussion, and the Third Edward Williams Lecture was delivered by Dr. C. H. Desch, F.R.S., who spoke on "Physical Factors in the Casting of Metals." A social evening, including a concert and dance, was held at the Assembly Rooms, and there was a whole-day excursion through the beauty spots of Derbyshire. Numerous local foundries and engineering works were visited during the Conference, and an excellent ladies' programme also contributed to the general success of the event. Visitors from Canada, Australia, Sweden, Germany, Persia, Singapore and Belgium participated.

LIEUT.-COLONEL J. H. M. GREENLY presided over the annual meeting of the British Non-Ferrous Metals Research Association. He pointed out that the membership was 256, and that the number of concerns directly dealing with the production, manufacture and use of non-ferrous metals was 3,000.

FOUNDRY WORKERS in South Wales received a wage increase of 7½ per cent. on gross weekly earnings.

SOME 650 PEOPLE, including a party of 45 British foundrymen, participated in the International Foundry Conference in Paris from June 17 to 24. The organisation was in the hands of the French Foundry Technical Association, presided over by Mr. Achille Brizon. Forty-six Papers from many countries were discussed at five technical sessions, and the round of social and educational visits included visits to the International Exhibition and the Louvre. Mr. Vincent Delport, Past-President of the London Branch of the Institute of British Foundrymen, as President of the International Com-

mittee of Foundry Technical Associations, took a prominent part in the proceedings of the Conference.

THE FIRM of Keighley ironfounders, Clapham Bros., Limited, celebrated its centenary.

July

THE SECOND annual cricket match between the Institute of British Foundrymen and the British Works Management Association, played at Lichfield, resulted in the defeat of the foundrymen by 265 runs to 53.

A ROYAL VISITOR to the works at Witton of I.C.I. Metals, Limited, was Prince Chichibu of Japan.

REDUCED RATES of duty on certain imported iron and steel products came into force.

A NATIONAL CAMPAIGN for the reclamation of scrap iron and steel, to relieve the shortage of this material, was launched by the British Iron and Steel Federation. A direct appeal to the general public was made by means of Press advertising.

THE MECHANITE INSTITUTE held its annnual meeting in London.

MR. HAROLD N. DAVIS, founder of the Davis Gas Stove Company at Luton, died at the age of 64.

MR. R. G. HOSKING was re-elected Chairman of the British Foundry School at the annual meeting.

August

SIR HAROLD HARTLEY was nominated President-Elect of the Institute of Vitreous Enamellers.

THE RT. HON. JOHN HODGE, who rose from steel melter to become the first Minister of Labour, and who was for more than 45 years actively associated with the trade union movement in the iron and steel industry, died at the age of 81.

THE DEATH occurred of Major R. A. Bull, one of the best-known steelfoundry metallurgists in America. He was a Past-President of the American Foundrymen's Association and a member of the Institute of British Foundrymen, to which latter he presented the A.F.A. Exchange Paper in 1923.

September

FOUR THOUSAND ENGINEERING WORKERS of Imperial Chemical Industries, Limited, received a 6½ per cent. bonus as a result of a new wage agreement.

THE FOUNDRY TRADES' EXHIBITION, in conjunction with the Shipping and Machinery Exhibition, was held at Olympia, London. There were about 30 exhibitors in the Foundry section, the chief criticism being the lack of representation of the equipment manufacturers. Many metallurgical exhibits of interest to foundrymen were contained in the Engineering and Shipping Exhibition, and interest attached also to the Welding Exhibition, the first of its kind held in this country.

THE AUTUMN MEETING of the Iron and Steel Institute took place in Middlesbrough.

THE 90-TON CAST-STEEL stern frame for the sister ship to the "Queen Mary" was despatched from the Parkhead Forge.

MR. F. J. R. MILES became the new Master of the Worshipful Company of Founders.

October

THE FOURTH ANNUAL CONFERENCE of the Institute of Vitreous Enamellers, presided over by Sir Harold Hartley, the new President, was held in Birmingham on October 8 to 10. Mr. Mellor, the retiring President, was unfortunately prevented by illness from attending. Mr. W. H. Whittle, the Chairman of the Institute, announced that membership stood at 200, and that during the previous session there had been 24 technical meetings as well as several works visits. The annual banquet was attended by 270 members and guests, the principal speakers including the Lord Mayor of Birmingham, the Earl of Dudley, Mr. C. W. Bigg, and Mr. Barrington Hooper. At the technical session Sir Harold Hartley delivered his Presidential Address, in which he stressed the need for and importance of co-operative research. Papers by Mr. W. E. Benton on "The Evolution of Enamelling" and by Dr.-Ing. L. Stuckert (Berlin) on "Stannic Oxide as an Opacifier in Wet Enamels," were discussed, and visits paid to the Birmingham works of the G.E.C. and the Triplex Foundry at Tipton.

SIR JOHN DEWRANCE died at the age of 79.

A 230-TON STEEL INGOT, the largest ever made in this country, was produced by the English Steel Corporation.

A SYMPOSIUM on notched-bar impact testing was held in Manchester by the Joint Committee on Materials and Their Testing.

THE BIRMINGHAM AND LONDON BRANCHES of the Institute of British Foundrymen held a joint meeting in Birmingham.

November

LORD DUDLEY, at the annual meeting of the British Cast Iron Research Association, launched an appeal for £40,000, to finance the B.C.I.R.A. scheme for provision of up-to-date accommodation and equipment.

THE STEEL ASSOCIATIONS covering the main basic steel products decided to maintain their current price levels until the end of 1938.

THE PIG-IRON loyalty rebate scheme came into operation.

THE BONNYBRIDGE refractory makers, John G. Stein & Company, attained their Jubilee.

December

THE RT. HON. J. H. THOMAS was the principal guest of London members of the Institute of British Foundrymen at the Branch annual dinner. A presentation of cutlery was made to Mr. H. W. Lockwood, in recognition of his services to the Branch as secretary.

A ONE-PIECE cast-iron propeller weighing nearly 20 tons was cast by Smith & Company (South Shields), Limited.

THOMAS FIRTH & JOHN BROWN, LIMITED, celebrated the centenary of the founding of the business.

THE BRITISH IRONFOUNDERS' ASSOCIATION and its kindred organisations, the National Light Castings Ironfounders' Federation and the British Bath Manufacturers' Association, held their annual banquet in London.

THE FEDERATION OF IRON AND STEEL MERCHANTS, centralising a number of different merchants' associations, was formed.

THE ORGANISERS of the Foundry Trades' Exhibition gave a luncheon, during which the views of the trade upon the future policy regarding the Exhibition were sought.

A COMPETITION for a slogan for cast iron was inaugurated by the British Ironfounders' Association.

The Foundry Scrap Trade

SO far as foundry scrap is concerned the year 1937 was in several respects rather a remarkable one. During its early months there took place a steady rise in the prices of scrap cast iron—a rise caused by an enhanced demand, not only for finished castings but for the products of virtually every branch of the ferrous industry which consumes scrap. Moreover, the market was not rendered any less "bullish" by the fact that many foundries were suffering from restricted supplies of pig-iron, with the risk of even further restrictions in the offing.

Nearing the summer, the appreciation in scrap prices became very marked indeed. Orders were heavy, in fact they were in some cases considerably in excess of consumption; and, despite the steelworks' control scheme which stabilised the prices of cast-iron scrap so far as the steel industry was concerned, there is no doubt that many founders regarded the position with some disquiet.

Towards the end of the summer, however, the market took on a different complexion. The majority of users found that cast iron was considerably easier in supply, and one may attribute this to several causes: among them without doubt was the satisfactory working of the steelworks' scrap scheme, and the normal operation of the laws of supply and demand, which caused many owners of obsolete machinery to be tempted by the high prices ruling for both cast iron and non-ferrous metals, and, consequently, to put in hand substantial dismantling programmes.

Another factor contributing to the decrease in prices was the over-ordering of scrap by some foundries during the earlier months of the year. The last half of the year was marked by progressive diminution of prices and, whilst a steady trade has been done, orders for cast-iron scrap have been much smaller and have barely absorbed the cast iron produced. Prices at the moment remain steady, although there is a slight increase in demand.

Expansion in the Iron and Steel Industry

The following particulars, issued by the British Iron and Steel Federation, relate to the expansion of the British iron and steel industry in 1937 in terms of output and earnings.

New Capacity

Figures now available indicate that the British steel industry is at present equipped to produce, and is producing, at an annual rate far in excess of 1929 or of any previous year. The output of steel ingots and castings for 1937 was 12,900,000 tons, representing an increase of 3,000,000 tons in the last two years, and comparing with 9,600,000 tons in 1929.

The process of scrapping and reconstructing the older plant, and of extending large-scale, integrated works, has been proceeding rapidly over the past few years.

Since the beginning of 1936 work has been accelerated in view of the unprecedented demand for steel, and new furnaces have become available rather sooner than have supplies of the necessary raw materials.

At the end of 1937 the aggregate steel furnace capacity of this country stood at 13,500,000 tons per annum, which compares with 12,750,000 tons at the end of 1936, and approximately 11,000,000 tons at the end of 1929. All existing furnaces are producing to the maximum rate.

Capital Expenditure in Recent Years

It is now estimated that the industry has spent £20,000,000 in new and reconstructed furnaces, mills, etc., in the two years 1936 and 1937. In 1929 new capital expenditure was £2,300,000. The industry's programme of re-equipment is not yet complete. Work is proceeding on large projects in South Wales, in Scotland, in Lincolnshire, and elsewhere, and these, it is estimated, will involve further expenditure of over £10,000,000 in the course of 1938. By the end of this year, steel-making capacity will have been further expanded to rather more than 14,000,000 tons per annum.

Noteworthy features of the industry as a result of those developments will be a larger pig-iron capacity at steelworks, increasing use of home-produced ores through the basic open-hearth and the basic-Bessemer processes, a big increase in the number of coke ovens at steelworks, and improved rolling mill practice.

Record Earnings

Record activity has resulted in record earnings by iron and steel workers. It is estimated that the total earnings paid in 1937 amounted to £49 million, which compared with £41 million in 1936 and £38 million in 1929.

Over the same period the percentage of insured workers employed has risen from 86.7 per cent. in November, 1936, to 89.4 per cent. in November, 1937, while the average earnings per week have advanced from £3 10s. 7d. to £3 17s. 6d. (October, 1937). The average earnings per week during 1929 were £3 1s. 6d.

Kinetics of Gaseous Reactions in the Cupola

V. K. TSELIKOV, writing in "Liteinoe Delo," 7, 1937, applies the theory of the kinetics of the reactions between carbon, carbon dioxide and carbon monoxide taking place in the foundry cupola, to the experimental data obtained by various investigators. The results confirm the view that the amount of carbon monoxide produced by reduction according to the equation $CO_2 + C = 2CO$ depends on the height of the column of coke above the tuyeres, the size of the pieces of coke and the linear rate of flow of the carbon dioxide through the bed of coke. The reduction of carbon dioxide by carbon being endothermic, an increase in the height of the column of coke, other things remaining the same, will be accompanied by a considerable loss of heat, and therefore excessive addition of coke should be avoided.

Research and Development Work in the Field of Non-Ferrous Metals

The series of articles on the following pages describes how the producers of various non-ferrous metals, either through their own organisations or through the development associations which they have sponsored, are fostering the uses of these materials in the foundry industry by means of research and the provision of aid in applying to practice the results of that research. In each case the information has been secured from official sources

Aluminium in the Foundry

THE past year has been one of great activity in aluminium foundrywork, both as a result of the general industrial revival and the increasing demands on the part of the aircraft industry in connection with rearmament. It has also been one of steady technical progress, particularly in the field of new alloys possessing properties almost undreamed of ten years ago. There are now a number of firms specialising in these high-duty alloys, and there is keen rivalry between them. The old low-strength simple alloys with copper, zinc and more recently silicon still find wide applications for lightly-stressed parts, but it is gradually being realised that the greater reliability of the newer scientifically-evolved alloys makes them worth the extra cost for all parts other than completely unstressed ones.

The consumption of aluminium in 1937 exceeded productive capacity, and the big stocks accumulated during the depression are rapidly disappearing. Many new plants have recently come into operation, and most of the big producers have extensions to their works well under way. In this country the third and last stage in the British Aluminium Company's water-power development at Lochaber in Scotland has been taken in hand during the year, and it is hoped to have the additional power available for metal production before the end of 1938.

Price Stability

It may perhaps be opportune here to point out the big advantage which the aluminium founder enjoys over those handling other non-ferrous metals, particularly those based on copper, zinc and tin, in the matter of constancy of price. It has for many years been the policy of the aluminium producers to keep the price of the metal constant, based upon a reasonable profit over average cost instead of allowing the price to follow the often wild fluctuations to which other metals are subjected, either as a result of the workings of the law of supply and demand or, as is more often the case, as a result of pure speculation. As a result the price of virgin aluminium has remained constant at £100 per ton over a great number of years and has not even now been raised following the rise in price of all raw materials, including those used in the production of the metal. It is interesting to note that the nickel interests have also for some time followed this practice, whilst the zinc producers are trying very hard to reach the same end, but so far without much success.

Research

Of all metals handled in the foundry, aluminium with its alloys has probably been the subject of more systematic and scientific study than any other metal. In addition to the work carried out by the British Non-Ferrous Metals Research Association and the National Physical Laboratory in this country on fundamental problems of melting and casting light alloys, most of the alloy manufacturers themselves now operate research laboratories, not only for the discovery of new alloys, but for the study of the best methods for handling and employing their products, and the result of all these labours is at the disposal of the foundry industry through one source or another, much of the data being embodied in Papers read before the Institute of British Foundrymen.

Grain Refinement

Research into methods of obtaining grain refinement in aluminium castings continues to occupy the attention of the British Non-Ferrous Metals Research Association, and most of this work has been published; one process worked out has been made the subject of a Patent. Further work is in hand on shrinkage in ingots and castings, and the effect of volume changes at solidification on the soundness of cast metals in relation to gas content, casting temperature and mould material. The often rather puzzling phenomenon of segregation and the still more puzzling one of inverse segregation also remain under investigation.

Degasification

As is well known, aluminium absorbs hydrogen fairly rapidly when in the molten state, one of the chief sources of contamination being water-vapour in the products of combustion, the oxygen combining with the metal to form oxide and the hydrogen going into solution and being liberated as pin-holes on solidification. A great deal of attention has been paid to methods of degasification in recent years and an interesting Paper on some experiments carried out in France was read by Prof. Chaudron before the Institute of British Foundrymen in June last. Prof. Chaudron draws the conclusions from these experiments that degasification can be overdone and that the foundryman has nothing to fear from gases properly dissolved in the metal, that is in equilibrium with the latter. He considers that overheating is the first enemy of the foundryman and that gases of combination should not be allowed to come into contact with the metal.

These views are not however shared by all foundrymen. It has been known for some years that the bubbling of chlorine or volatile chlorides, either alone or with a neutral carrier such as nitrogen, through molten aluminium is efficacious in removing occluded gas and this led Mr. Mann of the Fairey Aviation Company to carry out some practical trials to determine the effect of aluminium chloride on the properties of typical modern casting alloys. Metal melted in two types of furnace, coke-fired and oil-fired, was used for the experiments, using 25 per cent. virgin and 75 per cent. scrap metal. The aluminium chloride was introduced into the melt by wrapping it in aluminium foil and pushing to the bottom of the crucible. In all cases a marked improvement in mechanical properties and reduction of pinholing resulted, but it should be pointed out that the gaseous products of the dissociation of aluminium chloride are poisonous and if such treatment became part of regular foundry practice, proper means would have to be provided to prevent the fumes gaining access to the casting shop.

Heat-Treatment

One of the outstanding features of recent years is the increasing use of heat-treatment methods to improve the physical and mechanical properties of the finished castings, in fact practically all high-duty alloys now depend for their ultimate properties on some form of heat-treatment. This has as its object either the elimination of internal stresses set up through unequal cooling in the mould, some measure of grain refinement or a true precipitation age-hardening, based upon the technique employed for wrought alloys of the Duralumin type.

As foundrymen are in general more interested in practical matters than in the learned discussions on these and allied theories before the metallurgical societies it may not be out of place to explain in simple language the mechanism of age-hardening which is considered to account for the increase of strength without loss of ductility which results from the treatment. Both solid and liquid metals behave much the same as aqueous solutions; they are capable of dissolving other metals up to a certain saturation point, which is usually higher the higher the temperature.

Solid aluminium can, for instance, hold about 5 per cent. of copper in solid solution at 500 deg. C. but only about 0.5 per cent. at 20 deg. C. If an aluminium alloy containing 5 per cent. of copper be quenched suddenly from 500 deg. C. the copper has not time to come out of solution and what is known as a supersaturated solution is formed. If this supersaturated solution is now heated gently to about 200 deg. C. the copper will come slowly out of solution in the form of sub-microscopic particles of the eutectic compound $CuAl_2$ between the crystal boundaries and act as a sort of key to prevent intercrystalline slip.

Most of the newer heat-treatable alloys contain one or more of such added metals having varying solubilities in the base metal and capable of forming intermetallic compounds, either with the base metal or among themselves. The possibilities in this direction have probably by no means been yet exhausted.

Sands and Refractories

Increased attention is being paid to the refractories used in melting furnaces to avoid action on the molten metal, the tendency being towards the use of refractories at the alumina end of the silica-alumina diagram. The ideal material for crucibles and pots to hold molten aluminium is undoubtedly pure fused alumina, as not only is this material absolutely unattacked at any

temperature met with in the foundry, but the high heat-conductivity in the case of externally heated crucibles means a saving in fuel. Unfortunately the cost of such crucibles is at present too high to justify their employment except for special work in small sizes. The sands used in the foundry are also becoming the subject of scientific research, both as regards composition and grading, and scientifically graded synthetic sands will undoubtedly eventually take the place of natural sands in the light alloy foundry.

Supersonics

It sounds a far cry from castings to supersonics, but recent research indicates that this modern toy of the scientific worker, the popular pressman's "death ray," may one day play an important part in metallurgy; it may even solve the problem of segregation. Supersonics are sound waves above the audible range and they have been found to have very remarkable properties, particularly in connection with inducing or accelerating physical and chemical changes. Some experiments carried out in Germany on allowing alloys to solidify under the influence of supersonics have produced some interesting results, including marked grain refinement and alterations to the crystal shape and distribution of intermetallic compounds, particularly in the case of Duralumin and Alpax.

Permanent Mould Casting

Up to a few years ago the bulk of aluminium alloy castings were made in sand moulds, only small parts being cast in permanent metal moulds. The improved mechanical properties of castings made in metal moulds, due to the finer grain resulting from rapid cooling, has in recent times led to a wide extension of permanent mould casting, particularly for aircraft engine parts where strength is of paramount importance and justifies some increase in cost. Die-casting, on the other hand, where the metal is forced into the die under pressure, does not appear to have made the same progress, at any rate in this country, due possibly to the poorer mechanical properties resulting from porosity and restriction in the use of alloy mixtures.

Vacuum-Melting

This is a subject which continues to occupy the attention of certain firms, but the only people who seem to be making any real progress so far as aluminium alloys are concerned are the Heraeus Company in Germany under the direction of that arch-enthusiast of vacuum-melting, Dr. Rohn. Vacuum-melting means electric furnaces and electric furnaces are slow in getting adopted in this country, where fuel is cheap and electric power in general rather expensive. But electric furnaces are gradually finding favour, but whether the still greater step to vacuum-melting will ever be taken is a moot point, as the complications are still rather formidable. Probably the advent of magnesium founding may accelerate the movement, as the advantages are here perhaps more marked than in the case of aluminium.

Alloy Composition

No striking innovations in the matter of composition have been introduced during the year under review, but rather has it been a process of steady improvement of well-known alloy types by small additions of other metals or modifications of composition. The addition of small amounts of manganese or magnesium to the 12 per cent. silicon alloy, for instance, to make it heat-treatable has put up the mechanical properties without loss of the good casting characteristics of this very popular alloy type. There have also been further developments in the aluminium-magnesium alloy series, with magnesium contents up to 10 per cent. From the strength-weight ratio point of view the use of silicon and magnesium, both of which are lighter than aluminium, in place of the heavier metals, copper, nickel or zinc, offers material advantages, but so far all attempts to obtain still higher strengths by the addition of beryllium have failed—its only use to date has been for the hardening of copper alloys.

Copper Developments in the Foundry

WHEREAS the founding of copper and its alloys was one of the earliest arts known, the practice of making copper additions to ferrous alloys is still in its infancy. It is therefore perhaps natural that during recent years progress in the latter field should have been somewhat more rapid, not to say spectacular. This fact may serve to explain why, in this review of recent developments in the foundry, copper cast irons and steels receive a prominence which might appear out of all proportion to the tonnage of copper which they absorb.

NON-FERROUS FOUNDRY DEVELOPMENTS

In so far as the non-ferrous foundry is concerned, a growing appreciation by designers of the existence of copper-base alloys possessing engineering and chemical properties superior to those of the conventional phosphor-bronzes, gun-metals and straight brasses, has resulted in an increasing demand for the nickel-silvers, nickel-tin bronzes, silicon-bronzes and high tensile brasses, and has further emphasised the need for a more widespread knowledge of the somewhat specialised technique necessary for the casting of the aluminium-bronzes.

Bearing Bronzes

A new range of bearing bronzes has appeared on the market, which are essentially α copper-tin bronzes containing about 2 per cent. chromium, usually with iron. These alloys are reported to offer superior bearing properties under heavy-pressure and high-temperature conditions. They can be hot-forged as well as cast, and consist structurally of a hard chromium-iron constituent dispersed through an α copper-tin matrix. This structure is stable at considerably higher temperatures than that of the conventional duplex tin-bronzes.

Chromium-Copper Castings

Increasing interest is being displayed in the use of chromium-copper alloys for castings demanding adequate strength and high thermal or electrical conductivity, such as electrical switchgear components, automobile cylinder heads, blast-furnace tuyeres and cooling plates, and domestic boilers for use where the composition of the water prohibits the employment of cast iron.

When alloyed with between 0.2 and 1 per cent. chromium, copper exhibits temper hardening characteristics; moreover, in the tempered condition it possesses exceptionally high electrical and thermal conductivity. For example, an alloy containing about 0.5 per cent. of chromium (the normal content in chromium-copper castings) possesses, as cast, mechanical properties only slightly superior to those of copper with a Brinell hardness of 50, and electrical and thermal conductivity of about 40 per cent. When tempered at about 500 deg. C. for two hours, the strength is approximately doubled, the Brinell hardness

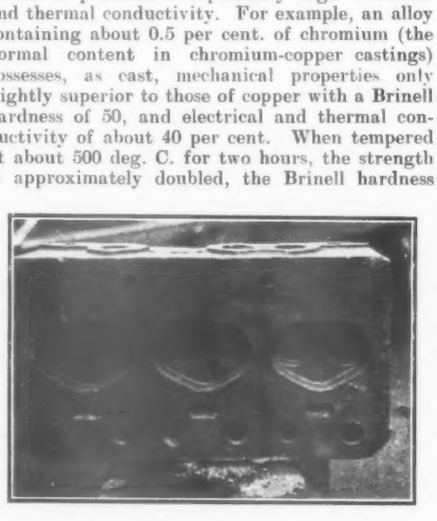


FIG. 1.—OVERHEAD-VALVE AUTOMOBILE CYLINDER CAST IN CHROMIUM-COPPER ALLOY.

raised to about 105 and the conductivity to 85 per cent. This percentage for conductivity may be compared with one of between 45 and 50 per cent. for a conventional "copper" casting containing 1 per cent. tin and deoxidised with phosphorus. A further advantage of chromium-copper castings is that they retain their strength at relatively high temperatures.

Foundry Technique

In view of the increasing interest which is being displayed in chromium-copper alloys, it will not perhaps be out of place to give a brief outline of a technique which has proved successful in their manufacture. Copper ingot or cathode of the highest purity, as used for electrical purposes, is melted in a crucible under a charcoal cover, care being taken that the crucible is free from pollution by iron or any other element likely to impair the conductivity of the metal. Thus, if iron stirring rods are used, they should be coated with a refractory. As soon as the necessary temperature has been attained, deoxidation is effected by means of an addition of 1 per cent. of electrolytic zinc. When deoxidation is complete, chromium is added usually in the form of a 10 per cent. chromium-copper master alloy, or, alternatively, briquettes of chromium and copper powders can be employed. After about 10 minutes the metal is poured quite hot, *e.g.*, at about 1,200 deg. C.

Dry-sand moulds are commonly used for chromium-copper, though small castings may be moulded in green sand with a fairly low moisture content. The bond strength of dry-sand moulds should be low, and cores, where used, should be friable, oil-sand cores with a sand to oil ratio of 40:1 being suitable. In view of the short freezing range of the alloy, venting should be liberal. Chromium copper is by no means easy to cast, and it is probable that a more satisfactory deoxidiser than zinc may be required for certain classes of work; but the alloy has been used with success even for extremely intricate castings, such as the overhead-valve automobile cylinder-head shown in Fig. 1.

Castings should preferably be shaken out as soon after the metal has solidified as possible. This procedure not only permits of unrestricted contraction of the metal, which is somewhat tender at high temperatures, but gives the air-quench necessary to hold the chromium in solution. Subsequently castings are precipitation hardened for two hrs. at 500 deg. C.

FERROUS FOUNDRY DEVELOPMENTS

Copper in Grey Iron

During the past two or three years extensive research has been carried out on the effect of copper in grey iron. The results of this work and the successful application of copper cast irons for many types of engineering castings have won for copper a position of some importance among the alloying elements of cast iron.

Simple copper additions are widely used for castings having thin and thick sections such as cylinder blocks, liners or pressure castings. In making such castings, the founder often finds himself between the "devil" of hard spots in thin sections and the "deep sea" of open grain

in thick sections. A simple copper addition, by its graphitising influence, will aid in keeping thin sections grey, and by its refining action both on graphite and pearlite will help to maintain a close grain in thick sections. Fig. 2 shows a heat of cylinder liners being poured in copper cast iron at a well-known foundry.

Copper is also being increasingly used in high duty irons in conjunction with additions of car-

[*Courtesy Hepworth & Grandage, Ltd.*

FIG. 2.—POURING CYLINDER LINERS IN COPPER CAST IRON.

bide-forming alloys such as chromium, manganese and molybdenum. In such irons, copper not only increases the strength and toughness to a very marked degree, but also balances the chilling effect of the carbide-forming alloys, thus promoting machinability. Fig. 3 shows some automobile crankshafts cast in copper-molybdenum Meehanite cast iron.

Copper in Malleable Iron

Copper is now firmly established in this country as an alloying element in blackheart malleable iron. Additions of up to 1.5 per cent. copper accelerate annealing, strengthen the matrix, whether it be ferritic or semi-pearlitic, and also produce considerable refinement in the temper carbon. The ductility is reduced somewhat as the tensile strength rises.

The addition of a graphitiser such as copper to malleable iron may necessitate a lowering of the silicon content to avoid mottling in castings; but fortunately copper has a much less powerful graphitising effect under conditions of casting than during annealing.

The strength of blackheart malleable iron is a function both of the strength of the matrix and of the size of the temper carbon nodules, the latter factor becoming increasingly important as the carbon content is raised, since the nodules become relatively coarser; thus the refining action of copper on the temper carbon has an even greater effect on the mechanical properties of high-carbon cupola irons than of low carbon irons, such as are more commonly manufactured in U.S.A.

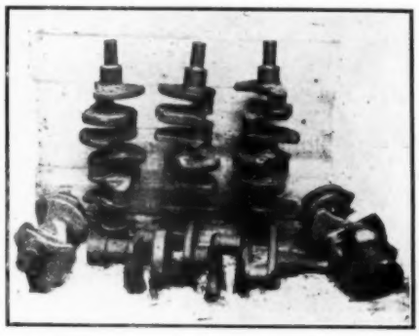
Copper improves the toughness of blackheart malleable iron considerably and is effective in preventing intergranular embrittlement after galvanising, thus counteracting the harmful effects of phosphorus and silicon in this respect.

The influence of copper on the mechanical and annealing properties of whiteheart malleable iron is at present under investigation. The results obtained to date are of some interest; for example, the addition of about 1.5 per cent. copper was found to raise the tensile strength of a whiteheart malleable iron in the annealed condition by 7 tons per sq. in., and the yield point by 5 tons per sq. in. Subsequent normalising and precipitation hardening of the copper iron increased the tensile strength by a further 8 tons per sq. in., and the yield point by no less than 14 tons per sq. in., giving a yield ratio of well over 90 per cent. In the annealed condition the copper addition increased both the elongation and bend values, which, however, fell back on precipitation hardening. The Brinell hardness of the precipitation hardened copper-bearing iron was 215 as against 118 and 141 for the copper-free and copper-bearing bars respectively in the annealed condition. Metallographical examination of the core structure showed the pearlite to be much finer and more uniform, and the temper carbon finer and more evenly distributed in the copper iron than in the copper free iron.

COPPER IN CAST STEEL

The use of copper in cast steel is a comparatively recent development chiefly pioneered in U.S.A. by Finlayson, Kinnear and the Ford Motor Company. The last named now uses between 1.5 and 4 per cent. in all its cast alloy steels, which range from low carbon steels to the special 1.5 per cent. carbon alloys used for crankshafts, brakedrums, etc.

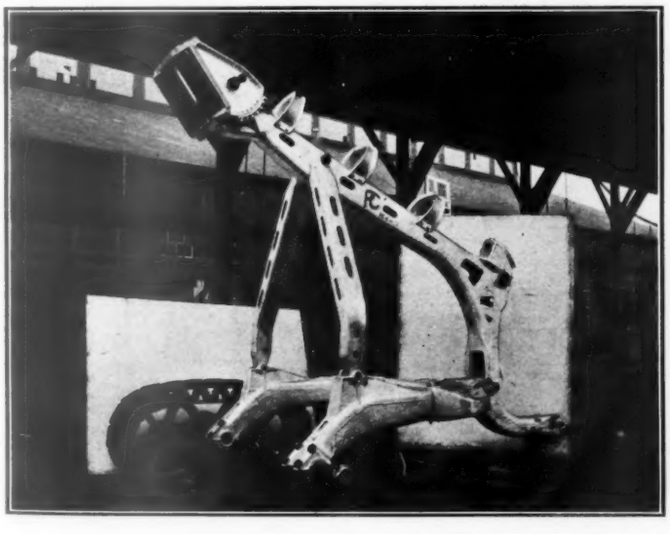
In addition to their low cost, the merits of copper cast steels are, briefly, fluidity, enhanced mechanical properties and susceptibility to low-temperature precipitation hardening, a form of treatment which is particularly suited to castings, especially those of intricate section or considerable size which cannot readily be given a quenching treatment.



[*Courtesy Ealing Park Foundry, Ltd.*

FIG. 3.—V-8 AUTOMOBILE CRANKSHAFT CAST IN COPPER-MOLYBDENUM MEEHANITE CAST-IRON.

During the past few years, a number of Papers have been published containing practical information regarding the manufacture and use of copper cast steels. This information has been supplemented by reports of research work carried out in U.S.A. and elsewhere, so that it is now possible to predict the influence of copper additions, both alone and in conjunction with the other common alloying elements, on the properties of low and medium carbon cast steels. The improvement in mechanical properties arising from simple copper additions may be illustrated by the fact that a 2.4 per cent. addition of this element to a 0.30 per cent. carbon cast steel raises the tensile strength from 38 to 54 tons per sq. in. and the yield point from 24 to 41 tons per sq. in. in the normalised condition, whilst an addition of only 1.20 per cent. copper to such a steel followed by precipitation hardening will give a tensile strength of 49 and a yield point of 37 tons per sq. in. In general,



[*Courtesy Pacific Car & Foundry Co.*

FIG. 4.—LOGGING YARDER CAST IN 2 PER CENT. COPPER STEEL.

[*Courtesy Pacific Car & Foundry Co.*

FIG. 5.—28-FT. STEAM-SHOVEL BOOM CAST IN ONE PIECE FROM 2 PER CENT. COPPER STEEL.

copper cast steels will have higher tensile properties as normalised, than after full annealing, but modified annealing which permits of considerable precipitation hardening will yield higher properties than will normalising.

Since copper, like nickel, is a "solid solution alloy," it is very effective in conjunction with carbide forming elements such as chromium and manganese, and the improvement in the mechanical properties of cast steels normally associated with such alloys will, in general, be superimposed on those obtainable by means of straight copper additions. For example, a tensile strength of over 60 tons per sq. in. with an elongation of over 16 per cent. is obtainable in a 0.30 per cent. carbon cast steel containing 1¼ per cent. manganese and 2 per cent. copper after normalising and precipitation hardening.

Fig. 4 shows a logging yarder made entirely of of 2 per cent. copper steel castings; the box section boom, cast in one piece through a single runner, weighs 950 lbs. and has an overall length of over 11 ft., with a maximum wall thickness of only ½ in. Fig. 5 shows a 28 ft. box-sectioned steam-shovel boom cast in one piece from the same copper steel.

Digby Steels.—Another interesting development is the new type of stainless steels containing from 16 to 18 per cent. chromium and from 8 to 10 per cent. copper, known as Digby steels. In certain media, these steels are reported to have a corrosion resistance commensurate with that of the well-known 18 : 8 chrome-nickel steels, and to combine excellent machinability with a wide range of mechanical properties which may be modified by heat treatment. Their casting properties are reported to be in no way different from those of straight high-chromium steels.

Lead in Foundry Practice

FROM THE LEAD INDUSTRIES DEVELOPMENT COUNCIL

IT might be objected that this Council has no right to appear in a series of articles dealing with the development organisations for the various metals used by the foundryman, since the amount of lead entering into normal foundry practice to-day is very small. As a justification, however, it would seem worth while to mention that lead was almost certainly one of the first metals to be cast. Archaic lead ornaments made in this way have been discovered in Egypt, dating back 2,000 years or more B.C.

As a decorative proposition lead is to-day relatively little used, although the amount is perhaps double what it was three or four years ago. The principal product is cast sheet, now used almost exclusively on ecclesiastical work. The methods of casting have not changed for generations, and at least one cathedral still possesses one of the actual tables used in mediæval time for casting the original lead roof. The old lead sheets are still from time to time removed, melted down, and a small amount of additional metal added to make up for the inevitable wastage and recast on this same table in identically the same way.

The work is specialised and presents many unusual features to the foundryman. As is known, the lead is poured into a container which serves to spread it across the table, the thickness being determined by running a strike or screed along the table following the movement of the metal. As a result the sheet will have solidified at one end before the other, and for this reason for normal widths up to about 3 ft. no allowance is made for shrinkage in the width, and only a quarter of an inch is allowed in 10 ft. for shrinkage in the length, although the known actual shrinkage of the metal will be many times this. The explanation is that the metal flows back under the strike as contraction takes place.

Reduces Pattern Costs

Another unique property of lead lies in the fact that embossed decoration, for such articles as flower pots or curved fascias, can be cast flat and afterwards bent up and leadburned together to the required shape. This, of course, reduces pattern costs enormously.

Apart from sand casting, a certain amount of work is done in cast-iron moulds of various types, and in this connection relatively large tonnages of the metal, generally containing antimony and sometimes small additions of arsenic, are used for the toy-soldier trade. The preparation of lead shot is also in a sense a foundry job. Extreme care is necessary in obtaining the correct alloy, since pure lead does not give a spherical shot but a slightly pear-shaped one. Correctly alloyed, the percentage of shot which is not truly spherical is negligible. The molten metal, containing small quantities of arsenic and some antimony, is poured through a sieve at the top of the shot tower. In order to ensure that the metal runs equally over the sieve and runs through in drops rather than continuous streams, a layer of porous copper is placed over the screen acting somewhat in the way that a sponge would act.

Leaded Bronzes

Finally, mention must be made of the use of lead additions to bronzes, a subject which is now being investigated in several countries and which has been reported upon by a Committee of the Institute of British Foundrymen. Allied to, and not generally considered part of the foundryman's trade, is the question of bearing metals, and here again lead is used to a considerable extent. Recent research suggests that pouring temperatures of such alloys are critical, and work is now going on to develop a cheap and robust temperature control instrument for this purpose.

Perhaps the largest single cast-lead outlet is the manufacture of battery plates. Since, however, this is almost invariably carried out by specialist firms manufacturing electrical accumulators, it tends to be overlooked when considering lead in relation to the foundry trade.

Work of the Council

The Lead Industries Development Council is somewhat differently organised from the similar development councils dealing with the other metals. In the main it has been financed by the firms responsible for the intermediate products rather than for the production of the ore and the smelting, and technically it is concerned primarily with the development of the use of sheet and pipe in the metal field, and of red and white leads in the paint field. A wide view is taken of the matter, but so far as the metallic section is concerned practically the whole of the work which has been done in the last few years, both of a strictly technical nature as well as publicity, has been concerned with the use of sheet and pipe in the

FIG. 1.—MOLTEN LEAD BEING RUN DOWN THE CASTING BENCH TO FORM A SHEET OF CAST LEAD.

building trade and in certain limited manufacturing fields. Such outlets for the metal as battery plates, electric cable sheathing, the toy trade, and similar fields, do not come within the scope of the organisation.

The Council set up towards the end of last year a Technical Information Bureau, to which consumers' technical problems can be addressed. In addition, the Bureau deals to some extent with the organisation of research in the industry and with the preparation of a variety of strictly technical information bulletins. A separate research laboratory is not maintained, the work being done at the British Non-Ferrous Metals Research Association, the National Physical Laboratory, and other organisations controlled by the Department of Scientific and Industrial Research. International contact is maintained with similar bodies in other countries, particularly France and America.

FIG. 2.—THE SAND BED ON A CASTING BENCH PREPARED FOR THE CASTING OF THE SIDES OF TWO DECORATED LEAD FLOWER POTS.

FIG. 3.—FLOWER POT FORMED AND LEAD CAST IN THE MOULD SHOWN IN FIG. 2.

Nickel in Ferrous and Non-Ferrous Foundry Practice

DEVELOPMENTS IN GREAT BRITAIN IN 1937

IN all branches of foundry activity 1937 has been a year of marked expansion and consolidation in the use of nickel and its alloys, and the records for the year prove a full justification of the nickel company's policy in reducing the price of the metal at a time when commodity prices as a whole were on the upward grade. Nickel now may be used as a constituent of nearly all foundry alloys, conferring its well-known benefits of grain refinement, improved foundry properties and generally improved mechanical properties, when used in small proportions; or of corrosion resistance and other special properties when employed as larger additions. Developments during 1937 in the more important fields of foundry production are briefly reviewed below.

NICKEL CAST IRON

Continuous progress has been made in the application of small additions of nickel in general iron-foundry castings. As in previous years, a considerable quantity of nickel was used to ensure regularity of production and uniform machining quality in castings of light or variable section, as, for example, in automobile cylinder blocks and especially in the more difficult types of design where a special problem arises in the maintenance of a high hardness and wearing quality in the cylinder barrels, while yet meeting the requirements of the machine shop in being easily machined at the thinnest sections. For the same reason, nickel is being used to an increasing extent in the production of light castings or in parts of varying section where a high quality is required for heat resistance or for maximum strength and pressure tightness in parts where the use of a low-silicon iron would tend to the development of chilled or hard spots, thus impairing machinability.

A direction in which an increasing interest is developing is in the use of engineering or high-duty cast irons containing 1 or 1.5 per cent. of nickel for applications where resistance to abrasive wear is of paramount importance. This applies especially in machine-tool castings in which the combination of good wearing quality on the ways and other parts exposed to abrasion, together with the high elasticity and general rigidity of the alloy irons, is of value. A particular case of great importance these days is in connection with liners for large diesel engines in which the wear resistance and rigidity coupled with a measure of heat resistance in low nickel-chromium types of cast iron are playing their part in minimising cylinder wear, especially on heavy-duty engines as used for marine applications. In smaller types of diesels, also, increasing use is being made of alloy irons for liners, and particularly in the case of those engines which are subject to arduous conditions of service as, for example, in driving compressors and other machinery engaged on public works or in locations where the equipment is exposed to the weather and bad and irregular operating conditions.

Again, in connection with chemical castings, engineers are appreciating to an increasing extent the fact that the density of grain and uniform structure promoted by small additions of nickel are of great value in minimising localised corrosion which is frequently caused by segregation and unsoundness or open grain in the castings. This, coupled with the improved resistance to corrosive attack shown by nickel cast iron, particularly to alkalis, renders the alloyed material especially suitable for caustic pots and similar castings.

High-Strength Cast Iron

One of the more outstanding developments of 1937 has been the growing interest taken by both engineers and foundrymen in the production of castings with abnormally high strengths. A special-process iron, known as "Ni-Tensyl," has been developed and has been employed successfully for many large parts, including crusher frames, machine-tool frames and parts, printing machinery, mining equipment, hoist drums, and for a large number of small components used in general engineering, such as cams, gears, racks and pinions, as well as for general castings for highly stressed parts and where superior wear- and heat-resistance is required.

An application of high-duty cast iron of special interest at the present time is for crankshafts. During the year a number of motor vehicle manufacturers have been experimenting, and are reaching the conclusion that for many applications cast iron can quite successfully and safely replace forged steel for this part. It is now realised that it is only a matter of time before many of the passenger cars and light commercial vehicles on the roads will be equipped with the cast shaft with the advantages it presents in the fabrication of complex designs and the economy offered for the production of smaller quantities of some of the simpler types of crankshaft.

Heat-Treatable Cast Iron

Alloy cast irons of the type proving of interest for crankshafts as mentioned above are used in the heat-treated condition both for this application and for similar duty in gears, cams, small cylinders, and so on. A particularly interesting example is in connection with motor vehicle cylinder-liners or cylinders of air-cooled engines in which an iron sufficiently highly alloyed to render the structure air-hardening is adopted. It is realised that the stability of the hardness obtained in such castings is of great advantage in resisting any "letting down" under the relatively high temperature conditions encountered on the surface of the metal in service.

"Ni-Hard"

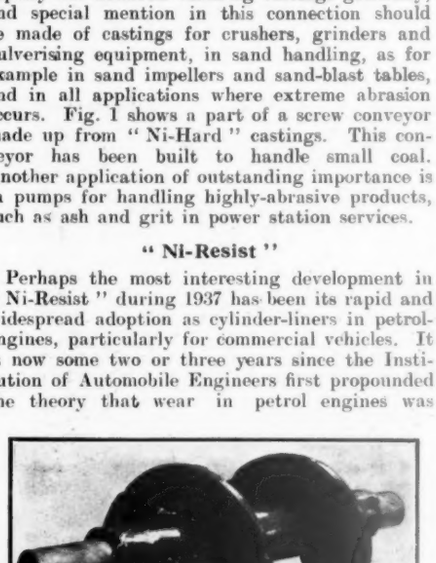
Undoubtedly the most important application of "Ni-Hard" is for chilled cast-iron rolls, and there is no doubt whatever that with the increasing use of modern rolling-mill methods and mill equipment the demand for alloy cast-iron rolls will rapidly increase. As justification for this statement it may be mentioned that already

in the United States 60 per cent. of the cast-iron roll production is alloyed with nickel.

Apart from the rather specialised field of rolls, however, "Ni-Hard" has been gaining ground rapidly for abrasion resisting castings generally, and special mention in this connection should be made of castings for crushers, grinders and pulverising equipment, in sand handling, as for example in sand impellers and sand-blast tables, and in all applications where extreme abrasion occurs. Fig. 1 shows a part of a screw conveyor made up from "Ni-Hard" castings. This conveyor has been built to handle small coal. Another application of outstanding importance is in pumps for handling highly-abrasive products, such as ash and grit in power station services.

"Ni-Resist"

Perhaps the most interesting development in "Ni-Resist" during 1937 has been its rapid and widespread adoption as cylinder-liners in petrol-engines, particularly for commercial vehicles. It is now some two or three years since the Institution of Automobile Engineers first propounded the theory that wear in petrol engines was largely of a corrosive nature, particularly in vehicles subject to repeated stopping and starting conditions. The appreciation of this fact led to further experimental work coupled with the solution of various problems in foundry technique in the production of liners in corrosion-resisting cast iron. As a result of all this work "Ni-Resist" cylinder-liners were produced and have been proved under conditions of arduous operation to offer a complete and satisfactory solution of the wear problem, and have incidentally also justified fully the corrosion-theory of wear. To-day these liners are used extensively for private cars and in addition two well-known makers of commercial vehicles have adopted them for the larger part, or the whole, of their output.



[Courtesy Ley's Malleable Castings Co.

FIG. 1.—ASSEMBLY OF SCREW CONVEYOR MADE UP OF "NI-HARD" CAST SEGMENTS, AND A SINGLE UNIT CASTING FOR BUILDING UP THIS TYPE OF CONVEYOR, WHICH HAS BEEN DEVISED FOR HANDLING SMALL COAL.

In the chemical field "Ni-Resist" has been increasingly adopted for such standard equipment as valves, pumps and fittings in contact with corrosive liquors, and the wealth of data gradually being accumulated on corrosion problems all goes to show that "Ni-Resist" is frequently not only the best cast iron available but is even better, for some purposes, than the usual non-ferrous alloys previously employed. A specially interesting application is in connection with automatic machinery for handling and weighing dry chemicals, this being a case like many others in which contamination of the product must at all costs be avoided.

The combined corrosion and erosion resistance of "Ni-Resist" is also being more and more appreciated, and has led to its increased application for pumping equipment in docks and harbours, and under similar conditions where corrosive liquid with solid in suspension has to be handled.

NICKEL STEEL CASTINGS

Major developments that have taken place during the past year have been in connection with the general technique of manufacture rather than in new compositions. The existing nickel alloy steel analyses commonly employed for castings range from the straight 1 per cent. nickel type to the more highly alloyed types such as the 4 to 4½ per cent. nickel-chromium-molybdenum compositions, and the use of castings to these analyses has extended in many fields. Within these ranges there are available a large number of compositions which are generally known and which meet the demands of the engineer for either high strength, resistance to wear and shock, or a combination of these properties such as are required for crushing and excavating machinery (Fig. 2), steel rolls, mining equipment, railway, marine and other general engineering purposes.

In addition there are the austenitic types of nickel alloy steel castings, containing higher percentages of nickel together with chromium and other alloying elements, which are used for special heat- and corrosion-resisting applications, as for example in boiler plant, metallurgical operations, furnace parts and chemical equipment.

Replacement of Carbon Steel Castings

For many years carbon steel castings have been found to be adequate, and no doubt they will continue to be used for parts which are not subjected to heavy stresses or are not required to resist wear. This is more or less the same position as that which one finds in the case of carbon steel forgings.

When, however, the necessity arises for obtaining, for example, high strength without increase of existing sections and without any sacrifice of ductility and toughness, together with uniformity of properties in large sections—that is, absence of mass effect or, alternatively, reduction of weight and yet still maintaining and even increasing the strength and toughness, there are two courses which may be followed. One is the substitution of castings by forgings and the other the employment of alloy steel castings. In the case of the former, the extent to which forgings may be used to replace castings is naturally very limited on account of their generally intricate nature, and can only really apply in the simplest of shapes and, even so, their employment would probably involve a considerable amount of additional machining work, and can thus be hardly considered a commercial proposition.

For these reasons nickel steel castings have largely come to the fore, and incidentally with the high strength properties now obtainable by suitable heat-treatment they can and are being utilised to replace carbon steel forgings, so reducing the amount of machining which is usually necessary in the case of complicated forgings.

Heat-Treatment

Up to quite recently it has been the practice to apply only a simple heat-treatment to steel castings, irrespective of whether they are carbon steel or nickel alloy steel. In the case of the former no material advantage is gained by an extended treatment, the usual practice consisting of annealing. With nickel steel castings, however, whilst nickel does confer improved mechanical properties on castings subjected to a simple heat-treatment, the full effect of the nickel addition, particularly when other elements are present, is intensified by further treatment. This follows the procedure applied to nickel alloy forging steels. The treatment may take the form of an anneal followed by oil, water or air hardening, and afterwards tempering to obtain the desired combination of hardness, strength and toughness.

[Courtesy Ruston-Bucyrus, Limited

FIG. 2.—NICKEL ALLOY STEEL CASTINGS ARE USED EXTENSIVELY IN THIS EXCAVATOR.

It is obviously impossible with some designs of steel castings to adopt a water-hardening or even an oil-hardening treatment on account of the risk of cracking, which is liable to be considerable, particularly where thin and thick sections are adjacent. For many purposes, however, where facilities do exist, nickel alloy steel castings can be safely water- or oil-quenched without any attendant difficulties. The ability of nickel alloy steel castings of certain compositions to respond to an air-hardening treatment has many advantages, particularly where the section is complicated and the risk of distortion is great, and castings weighing from a few pounds up to heavy masses are being regularly produced. Progress in this direction has been rapid, and such castings are finding extended uses in applications where resistance to wear or a high degree of resistance to wear combined with toughness and resistance to shock are required.

In the early days of the development of nickel alloy steel castings facilities for carrying out heat-treatment were not always available and in consequence the improvements obtained in the properties of the castings were perhaps not fully justified by the increased cost of alloy additions. It was soon realised that correct heat-treatment afforded the means of securing much greater improvement in the all-round properties of the material. It is in this respect that vast progress has been made in recent times, particularly with heat-treatment plant and the disposition of this plant in relation to the foundry and melting units. This reduces many manufacturing difficulties, especially as present-day treatment plant is almost entirely automatically controlled within narrow limits of temperature, which obviously simplifies the procedure very considerably. This not only results in reduced cost of supervision but also reflects in the uniformity of product which can be obtained under ordinary commercial conditions.

Melting Practice

Another sphere in which advances have been made is in the manufacture of the steel, and whilst it was generally thought that steel for castings did not require as much supervision and control as that needed for forgings, it has been realised that probably many of the troubles frequently encountered with steel castings, alloyed or otherwise, were directly traceable to the actual manufacture of the steel. In this connection much progress has been made in the selection of the raw material, the melting conditions and especially the production of properly deoxidised steel, thus following the procedure employed in the production of nickel alloy steel forgings for highly-stressed parts such as are used, for example, in the aircraft industry.

The practical experience and scientific knowledge applied to the manufacture of nickel alloy steel castings has therefore given to the engineer a material which can be used for the most severe duties, and that this is appreciated by those concerned with the design or use of engineering equipment, is shown by the widespread expansion in the use of such castings.

NICKEL IN NON-FERROUS FOUNDRY PRACTICE

Nickel-Copper Castings

The use of nickel in non-ferrous foundry practice covers a wide range of alloys. Commencing with the copper-base group, castings containing 4 per cent. nickel and 96 per cent. copper are being used in the electrical industry for slip rings on induction motors to minimise wear. The detailed requirements of alloys for slip rings are of a varied nature and the resistance to wear of any alloy employed for this service depends upon its structure, non-sparking properties, contact resistance, etc., and nickel-copper has been found to possess advantages not readily obtainable with brasses and bronzes which have been used for this application.

Nickel Bronzes

The addition of small percentages of nickel to the tin-bronzes has been found to promote solidity and density, homogeneity, grain refinement, wear and corrosion resistance and superior mechanical properties. In castings which have to be subsequently nickel plated it has also been reported that the use of nickel ensures better adhesion of the deposit. More recent investigation discloses the fact that the presence of nickel in copper-tin alloys enables the ordinary range of cast bronzes to be heat-treated, when high strength and hardness values can be obtained. It is important to note that in connection with obtaining improved properties in bronzes in the "as-cast" state the amount of nickel addition required depends to a very large degree upon the composition of the base alloy.

The full benefit of nickel additions to bronze castings is, however, not apparent until they are heat-treated, when precipitation or temper hardening is brought about and a wide range of useful properties obtained. At least 4 per cent. nickel and 4 per cent. tin are required for appreciable hardening to take effect, and the alloys become increasingly susceptible to treatment as the nickel and tin contents rise up to 8 per cent., slowing down again as this limit is passed.

It is rather remarkable to observe that by substituting nickel for 5 per cent. tin in Admiralty gunmetal castings and applying a simple heat-treatment, maximum strengths of 37 tons per sq. in. can be obtained associated with 16 per cent. elongation on 2 in. and Brinell hardness values of 171. Such properties are equal to those obtained from high tensile brass and are not unduly difficult to obtain in practice. There are many high-duty parts in all branches of engineering which could be profitably made in bronzes of this class, such as, for example, highly stressed gears and pinions, special bearing bushes, dies for plastic manufacture, pump impellers, liners, valve guides, non-sparking tools for use in explosive manufacture such as spanners and hammer heads, valves, gun-mountings and fittings and many other miscellaneous castings too numerous to mention.

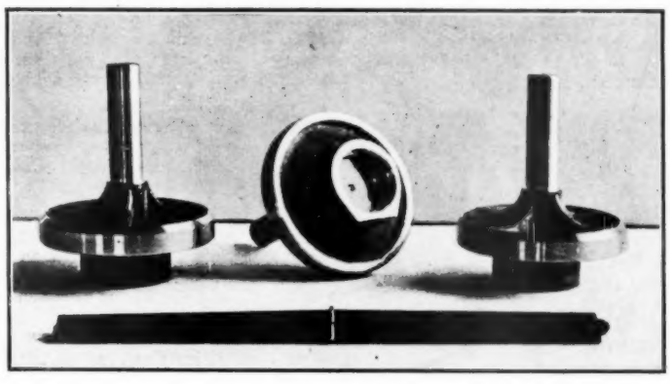
Bronzes containing over 10 per cent. nickel are being extensively employed for valve faces and fittings of all kinds for service with corrosive waters and steam. Those containing from 10 to 20 per cent. nickel with 5 to 10 per cent. tin are principally used for faces and parts of operating gear on sluice and pump valves handling corrosive waters, such as estuary and sea water, and also for hydraulic relief and safety valves where metal quality above the ordinary range of bronzes is essential for reliable service. Alloys containing over 20 per cent. nickel retain a large measure of their normal mechanical properties at elevated temperatures and are accordingly much favoured for various types of steam valve fittings as illustrated in Fig. 3. Furthermore, bronzes in this latter range can be produced with high hardness "as-cast" by the addition of silicon, when Brinell values of up to 400 and over can be obtained.

Nickel Brasses

Nickel developments in the copper-zinc alloy field are advancing rapidly. Twenty per cent. nickel-silver castings are finding increased application in many directions due to their attractive colour and service ability, whilst lower nickel additions to the brasses, in conjunction with aluminium, permit high mechanical properties to be obtained in view of their capability of being hardened by heat-treatment in a similar manner to that previously outlined for the tin-bronzes. The recent investigation on the question of cavitation erosion of metals by the American Institute of Mechanical Engineers, published in July of last year, has focused attention on the value of nickel additions to manganese brass marine propellers, and shows that the presence of 2 per cent. nickel makes alloys of this type 2½ times more resistant to cavitation.

Alloys for Bearing Purposes

Copper-lead steel-backed bearings are employed in internal-combustion engines for both motor vehicles and aircraft. The alloys commonly used for this purpose contain from 15 to 30 per cent. lead with around 1 per cent. tin, and the addition of 1.5 per cent. nickel has been found to be of considerable assistance in preventing lead segregation. The greatest factor against the more extended use of this type of bearing is that manufacture is beset with difficult production problems. As an alternative the use of cadmium, containing about 1.3 per cent. nickel, is suggested, as this type of alloy is relatively simple to produce, although at the same time much superior to the standard tin-base babbit metals. It should be noted that the use of copper-lead alloys is not recommended for service with soft shafts. Nickel is also an important constituent in the lead base bearing metals, being added in amounts from 0.7 to 1.5 per cent., and has found particularly successful application in cold-rolling mill and turbo-generator journal bearings.



[Courtesy of Steven & Struthers

FIG. 3.—NICKEL-BRONZE FITTINGS FOR STEAM VALVES.

In regard to the normal run of tin-bronzes, a bearing mixture reported to give good service with Nitralloy steel locomotive-pins contains 80 per cent. copper, 5.5 per cent. nickel, 11.5 per cent. tin and 3 per cent. zinc. In the course of a general investigation on bearing bronzes conducted by the U.S. Bureau of Standards a few years ago, it was found that, quite apart from the beneficial effect of nickel in preventing lead segregation, it also increased the resistance of the metal to deformation by "pounding." As little as 0.5 per cent. nickel addition to the 80/10/10 copper-tin-lead alloy improves toughness and shock resisting properties.

Several of the high nickel-tin bronzes previously described possess excellent bearing properties even in the absence of lubrication, and an alloy containing from 20 to 30 per cent. nickel with 8 to 12 per cent. tin has behaved satisfactorily for packing rings and thrust collars on centrifugal pumps.

Aluminium Alloys

Small additions of nickel have proved most advantageous in the light alloys, as shown by the well-known Y and R.R. series, and during the past year an aluminium base-alloy bearing metal has been developed for motor vehicle use. This alloy contains a small percentage of nickel, and road tests indicate its superiority over the white metals and leaded bronzes.

Monel and Nickel

As is now well known, Monel and nickel castings are readily available and extensively used

for corrosion resisting and other purposes. S. Monel is a recently developed modification, where a special hard casting is required for such purposes as valve seats, etc., and it is produced by the addition of approximately 3 per cent. silicon to ordinary Monel. Castings produced in this mixture have a hardness of 170 Brinell "as cast," but can be hardened or softened by heat-treatment between the limits of 120 to 210 Brinell.

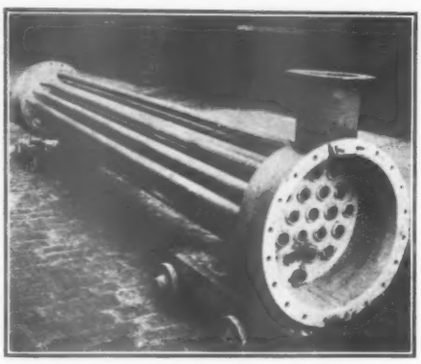
Monel for Welding Cast Iron

A use of a nickel alloy in connection with foundry work that has extended during 1937 has been the application of Monel welding rods for the repair of iron castings. It is well known that machining difficulties arise when cast-iron electrodes are used; by the judicious use of Monel, it is possible to make machinable welds in cast iron at a reasonable cost, and thus to save the heavy expense of grinding or the dead loss of scrapping a damaged casting. In many cases Monel is used only for the last two layers to give optimum result and economy.

Associated with this application is the employment of a 10 per cent. nickel nickel-copper-zinc alloy in place of brazing brasses to remedy faults in iron castings, the white colour of the nickel silver rendering the repairs indistinguishable from the parent metal.

Heat-Resisting Alloys

The complex nickel-chromium-iron heat-resisting alloys are most frequently employed in the form of castings, since they present some difficulty in working. Whilst no outstanding technical developments in these alloys have occurred during 1937, their field of application is extending for furnace purposes, special interest being shown in the pottery, glass and enamelling industries. In Fig. 4 is shown a typical nickel-chromium alloy casting which is evidence of the way in which such castings can now be produced and fabricated into quite intricate shapes. The unit is a furnace recuperator and weighs approximately 1 ton.



[Courtesy Cronite Foundry Co.

FIG. 4.—FURNACE RECUPERATOR MADE OF NICKEL-CHROMIUM-IRON ALLOY.

Nickel-Containing Permanent Magnets

The new types of nickel-aluminium or nickel-aluminium-cobalt permanent magnet steels now extensively used in the electrical and general engineering industries are essentially a foundry product, the magnets being used in the cast condition. During the year these new magnets have almost completely superseded the older types of cobalt and similar magnets in equipment of all sorts, and their development has sponsored the introduction of new tools and equipment of use to foundrymen and engineers generally. Special reference in this connection should be made to hand magnets in which the magnetic flux can be switched on and off, to magnetic chucks and separator plates of exceptional power, whilst in other applications, as in instruments, meters, microphones, and so on, the new magnets have added efficiency and power as compared with the older types of equipment embodying cobalt or other magnets.

The Tin Industry

Production

THE distribution of the world's tin supplies in relatively few areas has helped to make the tin-producing industry an example of successful production control. Productive capacity was excessive in 1929 and 1930, and stocks increased rapidly at a time of world-wide industrial depression. In February, 1931, the Governments of four of the chief tin-producing countries, British Malaya, Bolivia, Netherlands East Indies, and Nigeria, agreed to co-operate in a control plan to regulate tin production to the needs of the consumers, to reduce excessive stocks, and to restore the price to a level that would ensure profitable operation to mining companies and uninterrupted supplies to consumers. Subsequently, Siam, Belgian Congo, French Indo-China, Cornwall, and Portugal have participated in the scheme. In November, 1936, the agreement was renewed for the five-year period 1937-1941.

In the Malay Peninsular, which is the most important tin-producing area of the world, the ore occurs mostly in alluvial deposits and is won by dredging or by gravel pumping. The latter method involves breaking up the ground by water pumped at high pressure and separating the heavy tin ore by washing. Dredging is also common in the Netherlands East Indies, Siam, and Burma, while gravel pumping is usual in Nigeria; in Bolivia the tin occurs in lodes and underground mining methods have been adopted.

Tin ore from Malaya, Siam, Burma, French Indo-China, and Japan is smelted at Singapore and Penang, while ore from Bolivia, Nigeria, and South Africa is smelted near Liverpool. The Netherlands East Indies ore is smelted at Banka and in Holland. There are also smelters in Australia.

Consumption

The U.S.A. is the greatest consumer of tin, taking nearly half the world's total, and is followed by the United Kingdom. In the last year or two consumption has increased considerably, especially in U.S.A., U.S.S.R., France, and Japan; in Germany it has decreased, owing to restrictions in the interest of economic self-sufficiency.

A survey of the world consumption of tin shows that relatively little is used alone in the massive form; it is mainly used in conjunction with other materials. For example, in its major use (tinplate) tin forms only a thin coating (roughly one ten-thousandth of an inch) on both sides of a sheet of mild steel. Coatings of tin on steel or copper are also widely used in the dairy and other food industries, in electrical apparatus, water heaters, etc. Alloyed with other metals, tin is used in solders, bearing metals, bronzes, type metals, pewter, foil and collapsible tubes, etc., while tin compounds are used in the enamel, silk, and textile industries among others.

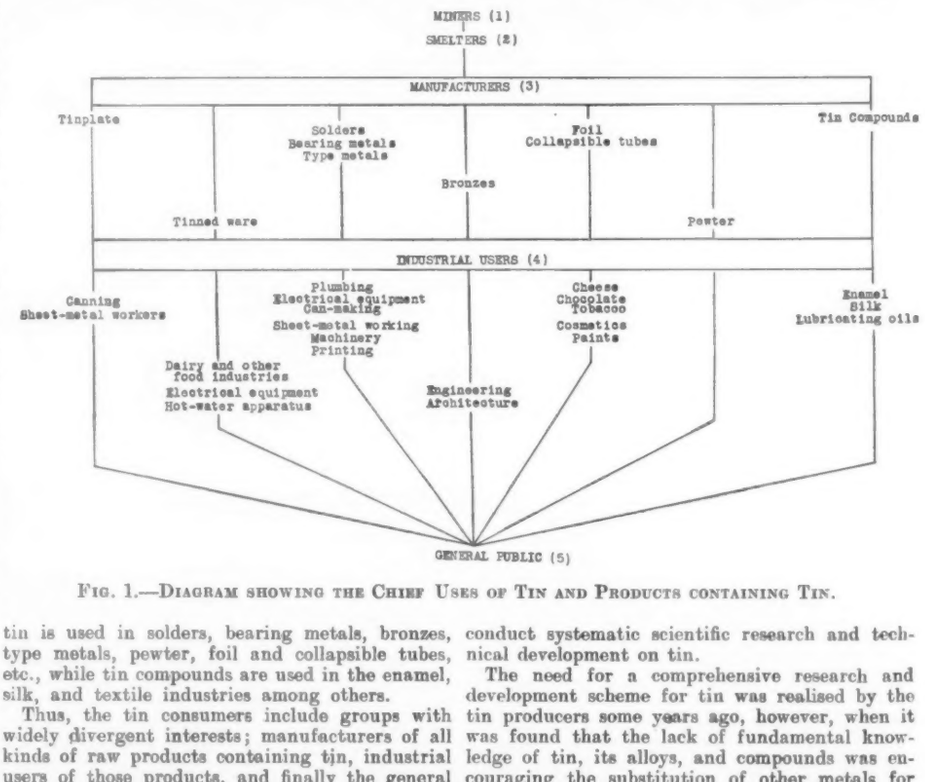


FIG. 1.—DIAGRAM SHOWING THE CHIEF USES OF TIN AND PRODUCTS CONTAINING TIN.

Thus, the tin consumers include groups with widely divergent interests; manufacturers of all kinds of raw products containing tin, industrial users of those products, and finally the general public. Fig. 1 shows schematically some of the more important industries using tin and their relation to the manufacture of products containing tin. Naturally, no attempt is made to give a complete picture, but the scheme does serve to show the wide variety of industries into which tin enters.

Research and Development

As tin is mostly used as an adjunct to something else, it follows that to each consuming industry tin is only one interest among others; consequently it would be difficult among such a miscellany of industrial manufacturers and users to secure the necessary cohesion and interest to conduct systematic scientific research and technical development on tin.

The need for a comprehensive research and development scheme for tin was realised by the tin producers some years ago, however, when it was found that the lack of fundamental knowledge of tin, its alloys, and compounds was encouraging the substitution of other metals for tin in many fields of application. The International Tin Agreement referred to at the beginning of this article includes the provision of a comprehensive programme of research into the

industrial applications of tin, carried out by the International Tin Research and Development Council with the aid of funds contributed by the Governments of the tin-producing countries. The Council was formed in 1932 and has its headquarters in London, where the Bureau of Technical Information is also situated, a Statistical Office at The Hague, and an office in New York. The research centres are spread in Great Britain, France, Germany, Holland, and U.S.A.

During the past five years the Council has been actively engaged in research and development on a great number of aspects of the tin-consuming industries, and has disseminated much technical and statistical information. About 100 publications of the Council have appeared, of which 70 describe the results of original research carried out for the Council. The results of this work are freely at the disposal of the tin-consuming industries, and have played their part in bringing about some of the advances discussed in the succeeding paragraphs.

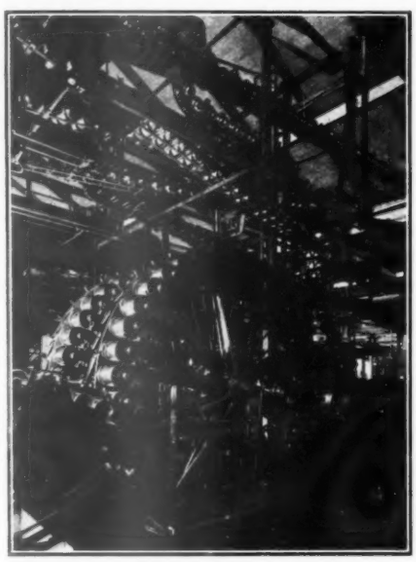


FIG. 2.—TINPLATE CANS—AN IMPORTANT OUTLET FOR TIN—BEING VACUUM-TESTED IN AN AUTOMATIC MACHINE.

It is natural that progress has been helped considerably by advances relating to other metals, such as steel, copper, and lead, in association with which tin is used.

Tin Coatings

The main use of tin is as a coating on other metals or alloys, chiefly steel, copper, and cast iron, especially in the food industries, where it has the outstanding advantages of a clean, bright surface, relative freedom from corrosion, non-toxicity, and ease of renewal.

Tinplate is the chief application, accounting for nearly one half of the world's consumption of tin. On the manufacturing side, considerable changes have been made in recent years in the rolling of steel sheet for tinplate. Cold reduction of the steel sheet has become definitely established in U.S.A. and plant for this purpose is now being put down in South Wales. The high ductility of cold-reduced tinplate has contributed materially to the manufacture of better stamped products. It is natural that advances in a newer process should stimulate improvements in the older method of pack rolling; further, changes are being made in the composition of steel for pack rolling in order to meet the more rigid specifications for cans and to produce greater ductility.

A modern development in U.S.A. is the substitution of electrically or gas-tube heated portable covers for fixed annealing furnaces for the steel sheet. The charge, consisting of stacked sheet or coiled strip, is protected by an inner cover of sheet-iron or alloy steel and heated by the portable cover which is placed over it. Eventually the cover is withdrawn, leaving the protecting inner cover, and used immediately to heat another stack of material, so that one portable furnace may serve three or four stands. Other advantages are that the material may be cooled more quickly without injury, the fuel used more efficiently, and heating better controlled and more uniformly distributed.

The availability of natural gas for large-scale use in U.S.A. has led to bright annealing of steel sheet for tinplate as a commercial proposition. Generally a dehydrated, partly combusted gas, such as cracked natural gas, is used; it is passed into the chamber around the charge throughout the annealing cycle. The operation of normalising furnaces with controlled non-oxidising atmosphere is also the subject of attention at present.

Normalising and pickling are being done more and more by a continuous process, and attention has been directed to the electrolytic pickling of steel sheet in a bath of fused caustic soda. The continuous tinning of wide steel strip is likely to be a commercially practicable proposition in course of time, while much interest has recently been attached to the manufacture of tinplate by electrodeposition of tin on to steel sheet.

Improved methods of testing tinplate, especially as regards porosity and thickness of the coating, have been placed at the disposal of the industry and are now very widely used in industrial laboratories. The whole problem of porosity, the causes and distribution of the pores and their influence on corrosion, has been the subject of extensive research and is fast reaching a satisfactory solution.

The consumption of tinplate in the canning industry has increased, partly due to an increase in the number of products packed. The canning of beer was started in U.S.A. in 1935, and in 1936 as many as 600,000,000 cans of beer were produced by one manufacturing company in U.S.A. alone. The canning of beer has also spread to England and other European countries.

Research on the tinning of copper has indicated methods of producing smoother and more uniform coatings.

Advances have also been made in the field of electrodeposition of tin, for whilst in the past it was difficult to build up more than a thin coating of tin by this method, there are now available several baths for the electrodeposition of tin coatings of any desired thickness and with excellent throwing power.

Tin Metal

Tin maintains its use in the form of pipe in the food and fine chemical industries, and tin foil remains the most suitable material for wrapping cheese. The use of collapsible tubes of tin has extended in recent years to their use as containers for numerous food products, such as mustard, cheese, and fish-paste.

Tin Alloys

Bronzes.—An interesting development is the production by a suitable degasification treatment of bronzes, containing up to 14 per cent. of tin, that can be hot or cold worked and show improved mechanical properties. In these alloys the structure is converted practically completely into the α phase. The properties of special bronzes containing additional alloying elements have been investigated.

Bearing Metals.—The conditions of service of bearings in internal-combustion engines have become increasingly severe with the progressive development of aeroplanes and motor vehicles. Much work is in progress leading to the improvement of tin-base bearing metals to enable them to withstand these more severe conditions. Among other innovations, the addition of a small amount of cadmium to the usual tin-antimony-copper composition has been found to improve the hardness, tensile and compressive strengths, and fatigue range.

Solders.—Solder is indispensable to an electrical age, and electrical equipment of all kinds, refrigerators, air-conditioning equipment, motor cars, etc., are a few modern necessities that ensure a good demand for solder. The continually increasing requirements have emphasised the lack of fundamental knowledge of the properties of these alloys, particularly as regards creep, fatigue, and the effect of small amounts of impurities. These properties are now being investigated.

Pewter. — Modern pewter contains about 92 per cent. of tin alloyed with antimony and generally some copper. Modifications in composition are being tried in the endeavour to obtain improved mechanical strength and resistance to tarnishing. An interesting innovation is the production of a hard black film on pewter and other tin-base alloys by anodic treatment in a hot solution of an alkali phosphate. By stopping-off certain parts of the surface, a pleasing contrast is produced, which lends itself to decorative effects.

[*Courtesy Ford Motor Co., Limited.*

FIG. 3.—POURING TIN-BASE BEARING METALS FOR MOTOR-CARS.

Other Alloys.—Research on the constitution of alloy systems containing tin has led to the production of new alloys, for which applications may be confidently expected to arise in due course. The mechanical properties of certain tin-base alloys can be improved by heat-treatment.

Tin Oxide

Tin oxide has long been used as an opacifier for vitreous enamels in the production of enamelled metal ware. It has been shown recently that the opacifier does not only confer certain desirable optical properties on the enamel, but also affects its coating power, thermal resistance, mechanical strength, and resistance to attack by acids. In these respects the beneficial effect produced by tin oxide is outstanding. Moreover, it has been found that the effect of tin oxide can be enhanced by suitable choice of composition of the enamel.

The American Foundry Industry

By OLIVER SMALLEY (H.B.M. Consul, Pittsburgh)

FOR the American foundry industry, 1937 has been a harried year. In its first half, markets, prices and profits rose; but labour, as is usual in a period of recovery, sought by strike to restore depression pay-cuts, to establish new high standards, and to perfect its organisation. In the second half of the year, labour has been more quiescent. but markets have shrunk and profits have tumbled.

Foundry Equipment

The splendid business conditions at the beginning of the year were no doubt responsible for the general decrease in the amount of equipment shown at the American Foundrymen's Association exhibit held in Milwaukee in May, the rumour being that most of the manufacturers of equipment could not keep pace with orders coming in and did not have machines in stock to use for exhibition or demonstration purposes.

One of the new pieces of equipment exhibited was the Beardsley and Piper new Speedmullor. This machine aims to use centrifugal force to mull 10 cub. ft. of sand every minute and a half, which amounts to about 22 tons per hr. at a consumption rate of 2 h.p. per ton of sand mulled per hour. This company also had on display a gyratory screen for handling up to 70 tons of tempered sand per hour as well as a new shake-out machine working on the vibrating principle.

The Clearfield sand mixer with its revolving bottom has been made more efficient through the use of an agitator which is supported by an arm and which is revolved in a horizontal plane by the turning of the bottom, thus causing a redistribution of the sand vertically as well as horizontally. The Clearfield also has scraper discs mounted so as to revolve in a vertical plane facing the stream of sand. Both turn freely, thereby consuming less power than if presented rigidly to the sand.

The Link Belt Company have developed a new sand preparation unit known as the "Sep-Aerator," which gives proper aeration of sand just before delivery to hoppers. This unit separates shot metal and refuse through different distance of throw from the sand.

The Mathews Conveyor Company introduced a shock-absorbing resiliently-mounted roller on their conveyor line.

The American Foundry Equipment Company have developed a rod straightener and shear machine, in five sizes, for use in reclaiming used core rods and steel gaggers. All of the machines are operated by compressed air with the exception of the ¼ in. rod type, which is hand operated.

In moulding-machine equipment, fewer features were introduced this year than in years past, due in all probability to the increased number of orders at this time.

Johnson and Jennings, on the 10 in. by 14 in. jolt-squeeze machine, have developed an adjustable squeeze-head of the pull-up open-head type with the squeeze-head locking mechanically when the squeezer plate is in the upright position. It is automatically unlocked when pushed back. This machine was equipped with wheels, but could be operated either portably or stationary.

The Tabor Manufacturing Company, in addition to their usual line, had a cantilever squeezer where the concentration of the pressure showed no tendency to shift sidewise, regardless of the condition of the supporting bearings.

Wm. Demmler Brothers presented their core-blowing machine of the diaphragm type of blow valve, actuated by a slide valve to get the full benefit of all available air pressure. This machine has a capacity of about 200 cores per hr. on small cores, and is proving one of the most successful on the market.

The Willsea Works of Rochester, N.Y., entered the exhibit field with their core and drying ovens using the thermo-syphon system. The basis of this oven is in carrying away moist air and supplying fresh dry air as needed. It is claimed that the baking time is decreased as the moisture in the core sand is withdrawn quickly, though

MR. OLIVER SMALLEY.

the cores are not overheated during the process of extracting the 2½ per cent. moisture in the core sand.

The Ingersol-Rand concern showed a new light-weight motor blower of ball-bearing construction where no foundations were required. Its principal uses apparently are in japanning ovens, crucible furnaces, annealing furnaces, core ovens and the like.

The Modern Equipment Company had on exhibition a cupola charger which consisted of a cylinder charging bucket with a bell-shaped bottom mounted on a cross-bar supported between two rails, which ran to the cupola charging door on electric power, discharging through the bell upon reaching its position in the cupola.

Grey Cast Iron

No outstanding new development or real technical progress in grey iron was seen during the year. The engineering industry as a whole has been educated during the past few years to expect more and more from grey cast iron, and possibly the greatest advancement of 1937 was an increased use of grey iron castings to replace more costly materials. To-day grey iron foundries as a whole are alloy-conscious, and there has been a large gain in the consumption of nickel, chromium, molybdenum and vanadium. There has been a definite increase in the installation of electric furnaces, particularly of the larger size units, both for cold metal and duplex melting purposes. Pig-iron specifications have seen some tightening, both in improvement of forms and sizes of pigs as well as a narrowing chemical specification to closer limits.

The cement type of mould is being accepted with wider favour in the average grey iron foundry, and extension of this method of moulding will be seen in the near future.

During 1937 most grey iron foundries have been employed at the highest rate of activity for years, and concentration has been obviously to improve facilities to step up production. A good deal of obsolete and worn-out equipment has been replaced, whilst the problem of an adequate supply of trained men is receiving more attention.

The Grey Iron Founders' Society has continued its good work. Amongst some of its most pertinent accomplishments last year was permitting a wide distribution of its simplified cost system to all members of the industry, thereby helping to establish uniformity in grey iron foundry cost accounting, and helping to prevent the everlasting competition of the factory which sells below cost through ignorance, which was an outstanding iniquity in the depression preceding this one.

The Society has furthered its agreement with the Association of Purchasing Agents defining terms of sale and responsibility for fire and other losses to patterns, machining of rejects, discounts, etc. This has eliminated much costly controversy and litigation incident to undefined responsibility.

A campaign of national advertising has been conducted, presenting new facts, helping to establish new contacts between customer and foundry. For employment, the Society conducts a free agency to cover foremen, metallurgists, sales engineers, managers and superintendents, thus effectively maintaining contacts between the man and the job.

Malleable Cast Iron

Possibly the outstanding development in 1937 has been in annealing equipment. This covers various types of short-cycle annealing, enabling a speeding-up of the time of delivery, particularly in cases of emergencies, which has always been a serious handicap to the expansion of the use of malleable castings.

This new type of annealing furnace designed and built by the Surface Combustion Company, Toledo, Ohio, eliminates the use of annealing pots by employing a muffle type of furnace, which not only assures quicker heating but has rendered possible the reduction of the malleable annealing cycle to 48 to 50 hours plus 15 to 20 minutes loading. This compares with the 6 to 7 days' cycle required with the regular equipment.

Common to the foundry industry as a whole, many malleable foundries have undergone a thorough rehabilitation, installing new and improved cleaning equipment and improving working conditions generally.

The year has seen an increase in the number of duplex melting installations to meet the needs of the so-called production foundry. These are providing a regular flow of metal for utilisation in connection with moulding conveyor systems.

There have been also marked advances in the so-called "pearlitic malleables" or metals with special heat-treatments and possessing different physical properties for special applications and uses. Molybdenum and copper have seen extended use in the field of alloy malleable.

With respect to volume of production, the malleable iron industry in 1937 will show a tonnage nearly comparable if not entirely so with

the period 1924-1927 and a tonnage approaching that in 1928-1929. The 1937 tonnage (for the first ten months) is 18 per cent. in excess of 1936.

Steel Castings

The first nine months of 1937 brought to the steel foundries a near-record volume of business. During that period the industry operated at 70 per cent. of capacity or better. In March, operations reached the phenomenal peak of approximately 105 per cent. of capacity. Since that date, however, the trend has been irregularly downward, and prospects for the balance of the year were for severely curtailed production schedules except in those plants still working on back-logs of heavy orders received months earlier.

Production costs have risen quite steeply, due principally to an average increase of about 20 per cent. in wage rates, together with a 25 per cent. price increase in scrap.

At the present time steel foundry labour is receiving over 60 per cent. of the normal production-cost dollar, while for a decade the proportion has seldom exceeded 50 per cent. of the normal cost dollar.

There have been several new steel foundries established and several have discontinued the production of commercial steel castings. Little change has taken place in the rated capacity of the industry.

Looking toward the future, the industry is studying the question of co-operative research in connection with improvement of its products and production methods. Advertising and trade promotional programmes are likewise receiving attention.

Plans are being formulated for work throughout the industry on matters such as improved job cost accounting, and the solution of operating problems for the purpose of increasing efficiency and reducing costs, thus paving the way for possible lower prices while at the same time providing products of improved quality.

Improved machinery and plant equipment would seem to have a very prominent place in preparing for 1938. Obsolete machines, tools and methods could profitably be scrapped and replaced with modern cost reducing equipment.

Business Conditions for 1938

Business and business prospects as measured by the basic industrial indices and expressed by trade sentiment, provide little encouragement that a lasting turnabout in the down hill slide of business activity is a near term probability.

The sudden summer turn in business has broadened into an important industrial recession and a realistic appraisal of the situation permits no optimistic conclusions. The unpleasant fact is that business prospects for the immediate future are poor. Steel has dropped to 30 per cent. of capacity, which is less than one third of the high rate of midsummer, representing a decline of nearly 65 per cent. Incoming orders do not even justify the present rate and operations may fall to as low as 20 per cent. of capacity.

In 1929-32, it required more than two years for steel activity to record a decline of proportions comparable to the decline of the past three months.

Railway purchasers, with a decrease in net earnings due to a fall in both freight and passenger traffic and increased wages and other costs, are likely to postpone as long as possible their orders for new equipment.

The motor-vehicle industry, which holds an important place in the economic structure of the U.S.A., shows an unfavourable trend, and this adverse result will be felt throughout all industry.

Building Construction.—Building costs, both in regard to material and labour, advanced in 1937 by 10 to 15 per cent., and this retarded building activity. Some decrease in costs during 1938 is possible and rents will tend to rise. Both of these prospects, together with the assistance that appears in prospect of government assisted housing recovery schemes, will obviously help residential construction later. The total building construction of 1938 is expected to exceed that of the past year, but no great benefit is to be expected therefrom.

Utilities.—It is anticipated that the utilities will increase expenditure this year, and whilst electric power production has fallen, a revival in equipment purchasing seems to be ahead.

Labour.—The outlook is better than it was a year ago and there are fewer strikes, less agitation and improved employer-employee relations.

With the fall in business of the heavy industries the foundries of the country have suffered a severe setback, this being the most severe decline on record for such a short period, three months. However, the situation is very different from 1929. There has been no excess speculation. The country has huge reserves of unused capital. There has been no undue expansion in business, and many factors could be cited which should have encouraged a sustained business recovery. There has, however, been an accumulation of excessive inventories in anticipation of higher prices, and the business decline is unquestionably an inventory recession, although leading economists who have tried to find an explanation for the tail-spin in reverse seem to agree that what ails both finance and business is a *fear* complex of taxes, politics and managed currency.

It is impossible to predict just how long or how far the depression will go. At the time of writing, it is thought that the decline will continue through all or most of the first half of 1938, but that it will not go much below present levels, and that it will not develop into another major depression because business debts are low, credit is cheap and the plentiful bank resources are not strained. Moreover, there have been little or no building activities.

A majority of opinion of authorities on the subject indicates that there should be an upturn this year. There are those, however, who maintain that the country is facing an emergency that is as real as that which existed in 1933. It has brought the majority to the verge of a practically unpredictable business situation for the next year or so. It is certain that a discouraging economic situation will exist for some time to come, confidence will be slow to revive and restoration of business to a prosperous level will be a slow and drawn-out process. However, one must not forget that America is a dynamic country, and when things move, they move fast.

Recent Developments in the French Foundry Industry

By A. BRIZON (President, French Foundry Technical Association)

Cast Iron

EXAMINING first the cast ferrous alloys, the dominating note corresponds to the fact that there have been years of very acute depression during which many foundries have made efforts to enter the field of high-grade and special products where apparently more remunerative prices obtained. In iron founding, the most prominent facts from the metallurgical point of view concern researches on the phenomena of graphitisation and the means of controlling and improving their mechanism in practice. In this connection, two principal directions have been followed in England and France.

In England, Pearce and his collaborators have perfected certain methods of treating ordinary molten cast irons for imparting to them a finer graphitisation and thus improving their quality, but in France, Portevin and Lemoine have perfected a method, also applied to molten cast iron, for creating an artificial graphitisation of promising form, even in the presence of very low silicon contents.

Both cases relate to cast iron treated after leaving the melting apparatus, and these methods are on the lines of present evolution which is returning the cupola to a place of honour for the development of grey irons of quality. This does not mean that hearth-type furnaces have fallen into disgrace, but it must be confessed that, in this connection, they are not now considered so indispensable as they were a few years ago. Nowadays, they are reserved more for the production of very special sorts of cast iron—malleable iron, alloys containing special elements, etc.

Renaissance of the Cupola

The cupola has regained this ground, or rather it has not lost that which it was on the point of losing, only because in addition to the treatment of molten cast iron just referred to, its own working technique has been improved by the use of judiciously designed fore-hearths and by the care exercised in the choice of primary materials, prepared in the foundry itself or purchased outside.

With regard to the special types of cast iron, foundrymen are mainly in a period of the practical application of previously perfected formulæ, the field of which is being widened daily, such as the development of ferritic cast iron for certain cases in which the castings are employed at an elevated temperature. The improvements in detail are furthermore quite numerous and show that foundrymen are anxious not to give way in the threatened or newly acquired fields.

From the point of view of moulding processes, the depression has evidently not been favourable to the development of mechanisation. However, various arrangements affecting more indirectly the cost have been improved, and one may cite for example the increasing use of pneumatic core-making machines. Equipment for the preparation of moulding sands and the technique of its use have also made appreciable progress, considerably reducing expenditure on fresh sand, rejects and cleaning costs.

Steel Foundry Practice

In steel foundry practice manufacturers are now engaged in preparing to enter upon the manufacture of more remunerative high-grade products. This has expressed itself in France by the serious development of the electric furnace of several tons capacity at the expense of the small acid converter. At the present time there exist in France barely four or five steel foundries possessing only converters for making steel castings. All the others, that is to say, at least thirty, possess open-hearth furnaces or electric furnaces or both.

The result of this growth in the electric furnace has been to popularise the so-called quality products, and it has tended to increase the applications of special cast steels. The use of nickel-chromium steels, for instance, has grown

considerably, and shipbuilding in particular is employing such steels on an ever increasing scale. The creation of the rail motor-car, by introducing the factor of lightness into railway practice, is also helping more and more to increase the consumption of high-grade products.

Manufacture is also benefiting from the general progress made in every country in metallurgical knowledge and processes. For instance, one may cite the following:—

(1) The use, of American origin, for the production of certain cast stainless steels, of ferro-chrome containing nitrogen, which results in a finer crystallisation in the castings.

(2) The attempt to apply to cast steel considerations concerning the size of grain, the importance of which is becoming daily more considerable for rolled and forged steels.

(3) The Czecho-Slovakian process of surface cementation of cast steel containing 12 per cent. of manganese by means of hydrogen, resulting after the usual heat-treatment in excessively hard martensitic layers supported by ductile austenitic internal layers.

(4) The development in France of oil-fired annealing and heat-treatment furnaces. This is mainly the result of economic conditions favourable to that fuel (*mazout*).

Moulding

From the point of view of moulding, reference should be made to a process of French origin which has been developed enormously in recent years in countries where natural sand is scarce. This is the process employing sand agglomerated with cement, the use of which has become general, particularly in the United States, during the past few years, and which is certainly also destined to extend elsewhere, owing to the advantages it affords over the classical methods from the point of view of labour.

For the inspection of castings, new non-destructive methods have been devised for revealing internal defects, methods based on the use of X-rays and gamma rays and magnetic spectra. The investigations carried out on these lines require to be followed attentively, and should be conducted prudently, methodically and in a practical spirit.

Malleable Cast Iron

In regard to malleable iron, recent evolution in the case of American blackheart iron concerns the perfection of more rapid annealing than before so as to reduce cost prices. Attention has also been paid to the production of high-strength blackheart malleable irons having a pearlitic structure with graphite in nodules. It is obvious that such a structure corresponds to low deformability (5 or 6 per cent.), but, on the contrary, the tensile strength attains values of the order of 32 tons per sq. in., capable in addition of improvement by heat-treatment.

The new alloys which some call cast irons and other steels are related to these forms. These are the alloys employed for casting Ford crankshafts, which are rather the offspring of blackheart malleable iron, since they are white when cast and are partly graphitised by subsequent heat-treatment.

These products are distinguished by their low total-carbon contents, restricting the number and influence of the graphite nodules, and they also contain chromium and copper. The treatment to which the castings are subjected after summary cleaning comprises graphitisation and quenching in still air. High mechanical strengths are thus obtained, coupled with good resistance to shock and, above all, to fatigue. This conquest which the foundry has made on territory reserved to forgings calls for special mention.

Copper Alloys

The metallurgist has devoted his attention to studying the influence of a certain number of elements in copper alloys. The use of metals such as nickel, aluminium, beryllium, silicon, iron and even titanium has distinctly increased, and it has been possible in this way to discover very definite applications, mainly connected with problems of corrosion, electrical conductivity, strength and hardness.

This furthermore singularly increases the range of copper alloys, the specifications of which could be simplified and standardised with considerable advantage.

It must be admitted, however, that very little progress has been made by the foundryman himself who, nevertheless, appears to have devoted his attention to the problem of melting: the cupola affords an improvement in the cost of production and radiation furnaces, heated electrically or by oil, reduce the loss on melting.

Light Alloys

All the rest is the history of the light and ultra-light alloys, always in a state of evolution, which have made appreciable progress in the course of the past few years, both from the point of view of the production of the basic metals and the preparation of the alloys and from the point of view of the knowledge of equilibrium diagrams and industrial application.

The manufacture of aluminium, with which are connected the illustrious names of Henri Sainte Claire Deville and Heroult, has been stabilised for some time now, but progress has recently been made by the use of electrolysis furnaces. Furthermore, the electrolytic refining of aluminium, perfected in America and improved by the Société d'Alais, Froges et Camargue, makes it possible to produce by the electrolysis of an aluminium-copper alloy an extra pure aluminium of a purity of 99.999 per cent., possessing a resistance to corrosion definitely greater than that of ordinary aluminium, as well as interesting electrical properties.

The industrial processes for the manufacture of magnesium have likewise undergone appreciable improvements in the course of the past few years, especially by the use of the chlorination of giobertite for producing anhydrous magnesium chloride, subsequently subjected to electrolysis, and by the perfection of gas-tight electrolysis furnaces enabling the chlorine to be recovered. These remarkable improvements are due to the researches of the I. G. Farbenindustrie A.-G. Moreover, the electrolytic refining and sublimation of magnesium *in vacuo*, perfected by Chaudron and Herenguel, have made it possible to produce an extremely pure metal, of a purity greater than 99.995 per cent.

The foundry practice of aluminium and light alloys is at present characterised by an increasing use of melting fluxes, de-oxidation and de-gassing, resulting in a more careful production of the alloys, avoiding the changes due to contact with air or the furnace gases. The investigations of the gases in aluminium, carried out in particular by Chaudron and Moreau, have improved existing knowledge of the quantity and nature of the gases absorbed by the metal during its fusion, and enabled us to appreciate more fully the value of the various de-gassing processes employed in industry.

With regard to magnesium and the ultra-light alloys, melting under a flux has now been universally adopted. Systematic investigations have made it possible to improve melting fluxes well adapted to magnesium foundry practice, and to vary at will the density and viscosity of the fluxes according to the intended purpose—melting, refining or casting. It may be said that it is nowadays possible to avoid with certainty the inclusions of chloride in magnesium, formerly very troublesome in the casting of ultra-light alloys.

A better knowledge of the casting properties of metals and alloys provides a guide for the foundryman in choosing the alloy possessing values of flowing power and shrinkage in agreement with the difficulties of the moulding operations which he has to carry out. As a result of the work of Portevin and Bastien the laws governing flowing power are nowadays well known, and the variation of the flowing power inversely with the solidification range has been verified for numerous types of alloys.

The methods of casting light and ultra-light alloys in sand or permanent moulds, now well perfected, have been completed by new methods, whereby it is possible to produce large series of small castings with a high degree of precision. The casting of light and ultra-light alloys under pressure, which has encountered considerable difficulties due to the corrosion of the crucibles and dies and to the alteration of these metals in the molten state, has now made appreciable progress, mainly due to the method of casting by injecting the metal in the pasty condition, a method first of all proposed for copper alloys. It is characteristic to note in this connection that it is the combined efforts of steel manufacturers and designers which have already permitted certain industrial processes to be realised and which, as they make progress, are opening up fresh prospects for the foundryman.

In the course of the past few years, the equilibrium diagrams of binary and ternary systems have formed the subject of exact determinations by thermal analysis, micrography and spectrography. These investigations have resulted in a better knowledge of the regions of solid solution and their boundaries at various temperatures, as well as of the intermetallic binary and ternary compounds.

Structural Precipitation

Furthermore, the phenomena of structural precipitation on which is based the heat-treatment of light alloys have formed the subject of profound researches which have shown the existence of a disturbance of homogeneity preceding the structural precipitation, this disturbance of homogeneity being accompanied by an increase in the hardness and strength. In this connection, Chevenard and Portevin showed at the last London Congress of the International Association for the Testing of Materials, the advantage of physico-thermal methods and in particular dilatometric analysis for shedding light on these successive phenomena in light alloys.

The modification of 12 per cent. silicon-aluminium alloy by sodium and the fluorides of alkali metals, which has long been known, makes it possible to obtain in these alloys, in the vicinity of the eutectic composition, a fine structure accompanied by good mechanical properties. Interest likewise attaches to the discovery, for aluminium-copper, aluminium-magnesium alloys, etc., of metals which when added in very small quantities to the molten alloy are capable of refining the generally coarse structure of light alloys cast in sand. The metals employed for this purpose are titanium, which is used more particularly for aluminium-copper alloys, molybdenum and cerium.

The improvement of light alloys by heat-treatment and structural hardening, generally employed for wrought alloys having high mechanical properties, is tending to be developed for castings, which, moreover, are previously subjected to annealing for homogenisation. The refining of the structure by means of the previously mentioned metallic additions, permits this annealing to be omitted in many cases, the subsequent treatment still retaining its entire efficacy. Examples of this are aluminium-copper alloys refined by means of titanium, and the aluminium-copper-nickel alloys and the more complex alloys refined by means of titanium or cerium.

Foundry alloys capable of heat-treatment have been developed to an extraordinary extent in the United States. It would appear that there is still much to be done in this field in France, where perhaps the light foundry alloys do not yet occupy the position which they deserve.

Aluminium-Magnesium Alloys

Regarding the aluminium-magnesium alloys containing from 4 to 12 per cent. of magnesium—generally 6.5 per cent.—they are progressing at

(*Concluded on page* 62.)

The German Foundry Industry

By Dr.-Ing. Th. GEILENKIRCHEN (Director, German Ironfounding Employers' Federation)

THE improvement in the general economic situation in Germany reported in the corresponding article a year ago has continued throughout the whole of 1937. In harmony with the economic situation throughout the entire world, all branches of German industry witnessed an extraordinarily heavy demand for products which, in the scope of improvements in the general living conditions of the nation, also reacted on trade and traffic and stimulated building activities in town and country.

A further circumstance which is more particularly engaging the serious attention of German industry is the execution of the four years' plan, the ultimate aim of which is to secure the independence of Germany in respect of raw materials, but which during the years of the transitional period calls for the very special exertion of all the industrial forces of the nation, particularly in the iron industry.

Raw Material Shortage

Consequently, all along the line, there has been no abatement in the intense activity of all foundries, whether producing consumer, constructional or engineering castings, and the anxiety experienced by foundries even in 1936 in regard to the purchase of raw materials has remained undiminished. In Germany, even by putting forth every effort, it has only been possible to minimise but not to eliminate altogether the shortage of pig and scrap felt throughout the world. It must also be borne in mind that 1936 was a record year in Germany for pig-iron and steel production, and that this upward trend was continued at the commencement of 1937, although it was still impossible to meet fully the ever-increasing demands of consumers.

This expansion of German industry naturally meant that some control of the distribution of raw materials was unavoidable. The purchase of all kinds of foreign metals, including both pig-iron and non-ferrous metals employed in the foundry, was possible only on a relatively small scale, first because, according to the principle of the " New Plan," foreign goods may not be imported to a greater extent than corresponds to the available currency obtained by the export of goods from Germany, and, secondly, of course, because the demand on foreign markets was just as heavy as in Germany, while various political events of world-wide significance, such as the Spanish Civil War, have considerably reduced the world output of ores, including iron ores. In so far as concerns the iron industry, there is the additional factor that the heavy demand caused the pig-iron prices to soar far above the price obtaining on the home market, while the contrary had been the case in previous years.

In the non-ferrous metal industry, where the necessity for the purchase of foreign raw materials is much greater than in the iron industry, the prices of German raw materials have adjusted themselves to the world market prices, while, on the contrary, the prices of German pig, which are controlled by the Pig Iron Association, have remained steady throughout the year. In view of the higher price, therefore, German iron and steel foundries have used foreign pig only in extreme cases. The exceptional heavy demands on the foreign markets having abated somewhat in the last few months, and prices having again fallen correspondingly, the use of foreign pig has also increased again to some extent.

Scrap Iron

The situation in regard to scrap cast iron was similar to that of pig-iron. The amount of scrap generally maintains a steady level, of course, or it is merely affected by the quantity of machines which were put into service a number of years previously and which, having become obsolete, can be discarded and scrapped. In periods of heavy demand, therefore, a shortage of scrap is experienced, and in the past year this has been intensified, owing to the considerable demands on all machines, by the general tendency to keep in service as long as possible even obsolete machines which would otherwise have been scrapped. Imports of foreign scrap were restricted for the very

DR.-ING. TH. GEILENKIRCHEN.

reason that many countries were themselves experiencing a shortage of scrap and had therefore placed an embargo on its export.

Rational Distribution

For all these reasons, the German iron industry saw itself obliged to distribute the available raw materials from rational points of view, so that those iron and steel products which are of importance for the execution of the four years' plan in regard to engineering and public services, for instance traffic, and which cannot be replaced by other materials, were given preference over all other products. The difficulty of the problem was in a certain measure increased by the fact that, in previous years, various products formerly made of non-ferrous metals, requiring foreign currency, had been replaced by iron and steel products, this having in its turn intensified the demand for iron and steel.

On the other hand, the synthetic resin industry and the ceramic industry have been highly developed in Germany, eloquent proof of which was afforded by a large exhibition held in Düsseldorf last year under the name of " Schaffendes Volk "—" A Nation at Work "—and visited by large numbers of foreigners, including residents of the British Isles. This being so, it was clear that the task of the supervisory boards of the iron and steel industry and the non-ferrous metals industry was to direct production so that products previously made of iron and steel would be replaced as far as possible by ceramic and synthetic resin products, while in addition, in many cases, cast iron manufactures would be replaced by those made of sheet steel, as requiring less metal.

Increasing Use of Magnesium

In the field of non-ferrous metal castings, there has also occurred a displacement from heavy to light metals. The same displacement is also to be observed in industry throughout the world, but for purely technical reasons. In the case of Germany, however, it has been of special importance because the use of light metals gives rise to fewer currency difficulties than that of the usual heavy metals. Even within the province of the light metals, however, the centre of gravity is shifting from aluminium to magnesium, a development which is not only parallel to that occurring in other countries, but which for Germany has the added significance that raw materials for the production of magnesium are available in unlimited amounts, so that the present-day requirements of magnesium can be covered by German raw materials many times over.

It is natural that German industry has utilised this technical possibility in every direction. The progress made in the use of magnesium in place of aluminium and other non-ferrous metals, and also to some extent instead of iron and steel products, was brought to the knowledge of the general public at a meeting held in Berlin in October, 1937, in conjunction with an exhibition of products manufactured from magnesium. The general interest in this development was shown by the exceptionally large numbers of visitors to the meeting, which made it necessary to arrange for a further exhibition to be held in Frankfurt early in 1938.

Reaction on Iron and Steel Castings

The considerable competition which the light alloy industry and the industry of substitutes thus caused to the iron and steel industry spurred the latter to continue with redoubled intensity the efforts to meet such competition in every way. In this direction, it was above all necessary to reduce the weight of castings, in order firstly to lighten the components made from them and secondly, by economising in iron, to remedy the shortage of that metal which had been the ultimate cause of the encroachment of the light metals on the market.

For a number of years, particularly under the influence of the competition of welded fabrications, the iron foundry industry, in view of the not altogether unjustified criticism that cast components required considerably more iron and steel than welded fabrications, had been endeavouring to reduce the wall thickness of castings by utilising to the fullest extent the increased strength of high-duty cast iron, particularly since research had shown that lightweight iron and steel components withstand permanent stresses at least equally well as heavier constructions requiring more iron. Such knowledge and efforts acquire enhanced importance in view of the necessity of making a larger number of finished products from an amount of raw materials that cannot be increased.

Attention has now been paid above all to effecting a reduction in wall thickness, not only in the case of constructional load-supporting parts, but also in the case of constructional elements whose dimensions have in the past been

selected solely in accordance with tradition or with a view to beauty of form or other external features. This category includes in the first place cast-iron pipes, both pressure pipes and discharge pipes, the thickness of which has for many years been fixed in accordance with standards substantially exceeding the dimensions actually necessary. The saving in metal by the reduction in wall thickness enables foundries to produce a larger number of castings from the same amount of iron The position is similar for many of the products of foundries producing consumer castings.

Economising Iron

In regard to machine construction, the director of a German engineering firm of world-wide reputation stated on the occasion of a meeting of technicians held last year that, in his opinion, a quantity of iron reduced by about 20 per cent. would be sufficient for the purpose of machine construction in the case of his designs.

At all events, there are many as yet unexhausted ways of economising raw material in this field. Included under this heading is also the fact, at one time often the cause for complaints, that some foundries by inaccurate work in moulding have in many cases exceeded the thickness prescribed by the engineering firms. The shortage of raw materials would appear here to be particularly capable of inducing such foundries to work more accurately and so increase the quality of the castings delivered. The improvements in moulding machines, which the German foundry machine industry broadcast to the entire world at the Düsseldorf Foundry Exhibition in 1936, have also proved fruitful in this connection.

Waste Reduction and Elimination

Furthermore, in all branches of foundry practice, the shortage of raw materials has had the effect of drawing particular attention to the problem of waste and rejects. Although formerly it was not to be denied that in many foundries there was a certain negligence in regard to the design of gates and risers, it may be said that nowadays such foundries with a view to effecting a saving in metal are directing their whole attention to reducing this waste to the absolutely unavoidable minimum. Even though waste metal finds its way back to the melting furnace, its quality is nevertheless impaired by the re-melting operation, while in addition some of the metal is irretrievably lost through oxidation.

The prevention of waste is of importance, not only with a view to economising in material, but also in regard to observing the current very long delivery periods. In this respect, the endeavours of the German foundry industry as a whole are running parallel to international efforts to reduce foundry waste, culminating in the decision made at the last Foundry Congress in Paris to appoint an International Committee for the Prevention of Waste.

Cost Control

As already pointed out in last year's report, the stricter control of foundry costing methods, supported by the increased demand for castings, has resulted in an equalisation of the prices of castings which only in a few cases, particularly in regard to consumer castings, has not yet been achieved to the extent considered necessary. In the case of the foundry industry, the principles underlying modern economic views have thus been accounted for in part, namely that the immoderate drop in prices in times of low demand must be prevented. On the other hand, however, it was necessary to direct economic control mainly with a view to preventing an immoderate rise in prices in consequence of the demand substantially exceeding the supply. In the late autumn of 1936, the German Government prevented the further rise in the prices of all commodities by prohibiting their increase above the prices prevailing at an earlier reference date, October 18, 1936. This prohibition even affected those prices which were perforce recognised as insufficient on the basis of a costing calculation properly carried out. In such cases, specially permitted higher prices could be quoted and paid only by way of exception. It must be admitted that where there was a justifiable reason, permission was also granted to increase the prices. However, taken on the whole, this measure brought about the necessary stabilisation of prices.

A Price Fixing Decree

This decree, known as the price fixing decree, was provided as a temporary measure, and was intended to be replaced as soon as possible by the organised establishment of prices, whereby, for each branch of industry, the actual costs of normal production are determined as far as possible according to a uniform system, the selling prices being based on such costs. This was primarily intended to enable well-equipped and properly-conducted works to operate with a reasonable margin of profit and always at a modern level by discarding obsolete plant. For this purpose, it was necessary that the book-keeping should be carried out in every undertaking according to a uniform plan and should then be used as a basis for the proper calculation of the manufacturing costs.

This task was imposed on the entire German industry by the Government economic control, and had been carried into effect on broad lines by the end of 1937. As is also well known outside Germany, the German iron foundries have been pioneers in this direction. As early as 1919, in the so-called "Harzburg Pamphlet," which the Association of German Iron Foundries issued at their annual meeting in Bad Harzburg, they laid down the costing principles generally applicable to iron foundries in Germany, which in the course of the past 18 years have actually become common among the foundries.

It was therefore clear that in the trend of the modern price policy, the German iron foundries were the very first to be allowed a costing cartel, which, on the basis of compulsory co-operation, imposed on the foundries the task of computing their costs according to a uniform system and fixing the selling prices in agreement. This was done on the assumption that the best-equipped and best-conducted foundries would lead the way in regard to the fixing of their prices and would stimulate their competitors in rivalling them in cheapened production. Such a development was only possible on the basis of comparisons made between undertakings manufacturing the same products and in order to do this, the actual working expenses had to be ascertained according to a uniform system. Consequently, the German iron foundries and also the German non-ferrous foundries, where the costing system has been developed along similar lines, have devised on the principles already obtaining last year a system of book-keeping and costing which was published at the end of November on the occasion of the annual meeting of German iron foundries. This system is obligatory for all foundries.

This to some extent has brought to a conclusion the development of the price policy of German foundries. The new regulations, which are to be put into practice in the near future, will afford the guarantee to the foundries that the results of their efforts to produce good, sound castings on an economic basis will not be diminished, while they will also assist in enabling industry as a whole to turn to good account, both technically and economically, the results of an ever-progressive technique which, appropriately applied to the respective undertakings, will also increase the competitive powers of the German manufactured products industry.

German industry has no intention of flooding foreign markets with German goods, but desires to export in a reasonable manner its surplus of industrial products to countries which cannot manufacture such products for themselves, and to import in exchange agricultural products and industrial raw materials which it requires for its own purposes. German foundries have for many years co-operated in the achievement of this object. During the economic depression, now happily past, the foundries were absolutely at the mercy of uncontrolled competition. Now that those troublous times are over, they will have to exert all their technical and economic efforts towards supplying the necessary foundry products from a limited quantity of raw materials, while utilising the most up-to-date technical means of the manufacturing industry. A guarantee that in the long run they will be in a position to accomplish this task is afforded by the progress made all along the line, evidence of which was given by the Düsseldorf Foundry Exhibition in 1936 and in the furtherance of which no efforts will be spared.

Recent Developments in the French Foundry Industry

(*Concluded from page 60.*)

a rate which promises a very remarkable future for them. Having been definitely perfected in the course of recent years, they have the advantages of a very high capacity for deformation when they are made from very pure metals—a fatigue limit which is constant in time, whereas aluminium-copper alloys, which are very sensitive to corrosion, have fatigue limits which are lowered rather appreciably by the action of atmospheric agents—and finally a remarkable resistance to corrosion. Employed without heat-treatment up to 7 or 8 per cent. of magnesium, these alloys appear destined to occupy a place of distinction in the construction of seaplanes and in shipbuilding.

Moreover, the progress already made in the field of ultra-light alloys is far from terminated. It is merely necessary to recall that the researches carried out at the National Physical Laboratory have resulted, in particular, in the production of three ranges of magnesium-aluminium-cadmium alloys, magnesium-aluminium-silver alloys, and magnesium-aluminium silver alloys with slight contents of cobalt and manganese, some of which possess strengths comparable with those of aluminium light alloys, while others have the great advantage of retaining good mechanical properties up to 300 deg. C.

In conclusion, the author feels that he cannot do better than to quote a statement made some time ago by Prof. Portevin when a masterly Paper on ultra-light alloys was read by Mr. Bastien to the Société d'Ingénieurs Civils:—

"Let us compare this rapidity of perfection and precision, with which the present working conditions of the casting of magnesium have been defined, with the scarcely perceptible evolution of bronze founding in the course of a thousand years and its present position.

"For the casting of magnesium, an entirely new operation where everything had to be created and in regard to which traditional experience was completely at a loss, it was necessary to appeal to the rational notions and experimental methods dictated by education and scientific research, whereas elsewhere their penetration encounters deeply-rooted customs and traditions."

American Iron and Steel Institute

The directors of the American Iron and Steel Institute have decided to limit attendance at the general meeting on May 26, 1938, to individual members of the Institute. This decision followed criticism by members of the crowded conditions at the general meeting last May and at previous meetings. The limitation will be applied to all sessions, and members will not be permitted to invite guests to the annual banquet.

The Czecho-Slovakian Foundry Industry in 1937

By Prof. Dr. Mont. Fr. PÍSEK (President, Czecho-Slovakian Foundrymen's Association)

THE increased activity which the Czecho-Slovakian foundries experienced towards the end of 1936 gave reasonable hope for its favourable development during 1937. These hopes proved to be not only justified but were actually largely surpassed. The extent of the development is well exemplified by the production figures relating to raw materials.

TABLE I.—*Production of Pig-iron during the First Ten Months of the Years* 1929–1937.

Year.	Tons.
1929	1,363,474
1930	1,215,105
1931	1,016,960
1932	381,847
1933	419,048
1934	507,843
1935	651,777
1936	917,728
1937	1,387,005

The output of pig-iron from January 1 to October 30, 1937, even exceeded the maximum output of the period of the highest production peak in 1929, as is shown in Table I, which gives the production of pig-iron during the first ten months of the years 1929 to 1937.

TABLE II.—*Raw-Steel Production for the First Ten Months of the Years* 1929–1937.

Year.	Tons.
1929	1,740,258
1930	1,487,923
1931	1,285,477
1932	523,816
1933	637,269
1934	816,842
1935	972,212
1936	1,245,931
1937	1,917,407

Table II shows the general tendency of the steel industry, indicating the quantity of raw steel produced in the first ten months in the years 1929 to 1937. As may also be seen in this sphere, the output in the ten first months of the year 1937 exceeded the output associated with the boom year 1929. The direct export business in pig-iron has also increased, the figures for the first ten months of 1937 being shown in Table III. Another favourable indication of the increased activity of the metallurgical industries is coke production. The outputs in metric tons of foundry coke for the period under review are set out in Table IV.

PROF. DR. MONT FR. PISEK.

The supplies produced in 1937 represented about 80 per cent. of those produced in 1929, and thus an improvement in the production of coke in the last year has been registered. To judge from the orders already placed, this position will be maintained for at least the first half of 1938.

The activity of foundries producing consumer castings was considerably greater than in the year 1929, which was the year of the maximum production since the Great War. The output of these foundries increased in some plants by as much as 40 per cent. compared with the year 1936. This was due to intense activity in the building trades, no doubt influenced by the building subsidy which was recently renewed for a period of two years and to the important orders received by the various engineering works.

As far as actual builders' castings are concerned a slight recession took place. Cast-iron stoves—until recently a popular line—are now very little in demand; pillars, formerly made exclusively of cast iron, are now made of steel section or of concrete, whilst decorative castings have been replaced by sheet metal work. Only in pipes has cast iron maintained its position in spite of the intense propaganda made for steel tubes. Foundries specialising in the production of cast-iron pipes are working at full pressure to produce material for the new Prague water scheme.

TABLE III.—*Direct Export of Pig-Iron in the First Ten Months*, 1937.

	Tons.
Basic pig-iron ..	215
Foundry pig-iron	4,336
Hematite	3,199
Total	7,750

TABLE IV.—*Coke Production and Sales.*

	1929.	1932.	1936.	1937 (estimated)
	Tons.	Tons.	Tons.	Tons.
Production ..	188,000	78,000	107,000	150,000
Inland sales ..	80,000	39,000	44,000	58,000
Export sales ..	98,000	36,000	57,000	85,000
Total sales..	178,000	75,000	101,000	143,000

The foundries making engineering components are also very busy. Here the output increased in some cases by 60 per cent. as against the year 1936, as for instance the Vitkovice Iron Works. Amongst the castings produced by these works one of the more interesting is a drying cylinder for a paper-mill. It is of 10 ft. 8 in. dia., 7 ft. 2 in. long, and weighs 9 tons. The casting is illustrated in Fig. 1.

During the year more attention was paid by

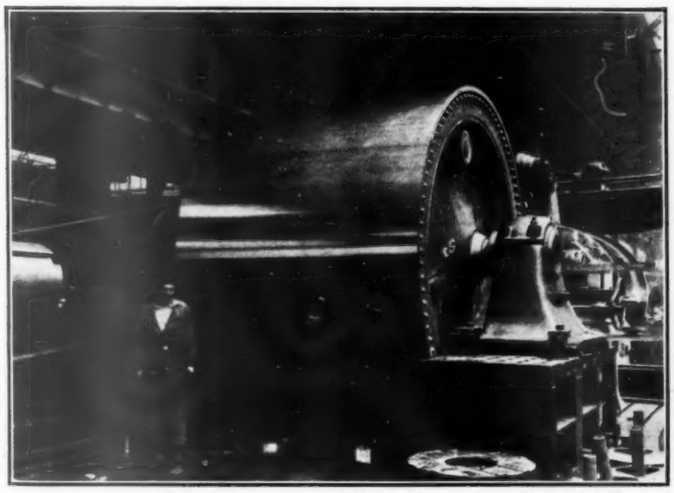


FIG. 1.—DRYING CYLINDER FOR PAPER MILL, BY THE VITKOVICE IRON WORKS.

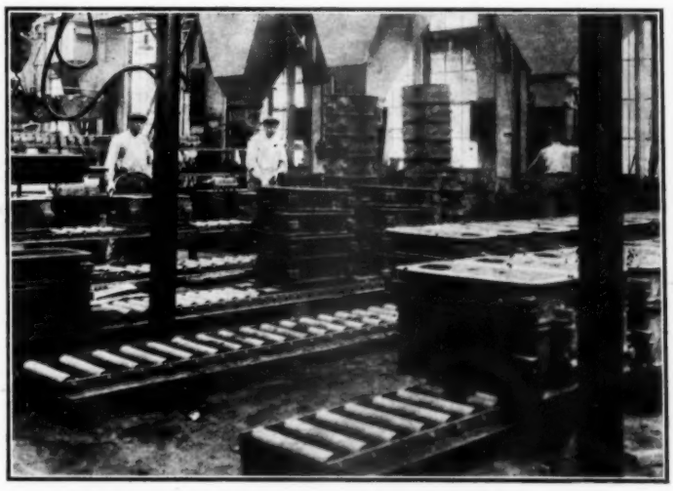


FIG. 2.—CONTINUOUS-CASTING FOUNDRY OF CESKOMORAVSKÁ-KOLBEN-DANEK IN PRAGUE.

the iron foundries in the direction of the more economical working of cupolas; some plants have adopted the balanced blast system of the British Cast Iron Research Association.

Some foundries, especially those producing large quantities of small castings, have modernised their plant, and the motor-vehicle castings division of the Ceskomoravská Kolben-Danek, the new iron foundry at Prague, shown in Fig. 2 is a typical example.

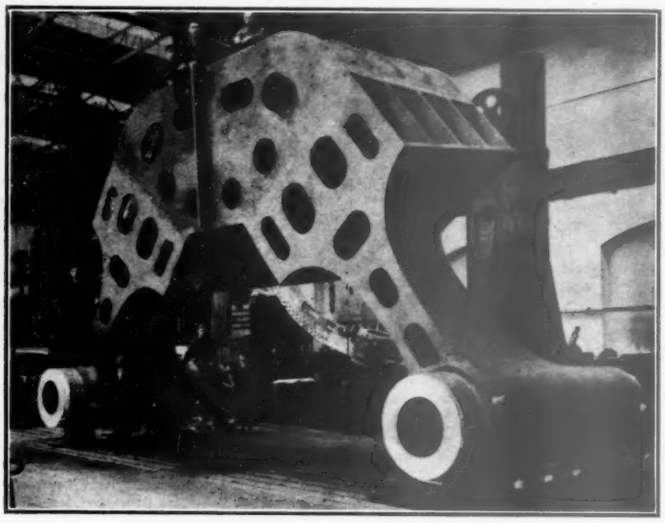


FIG. 3.—PROPELLER BRACKET IN TWO PARTS, WITH CONNECTING PIECE, CAST IN THE SKODA WORKS.

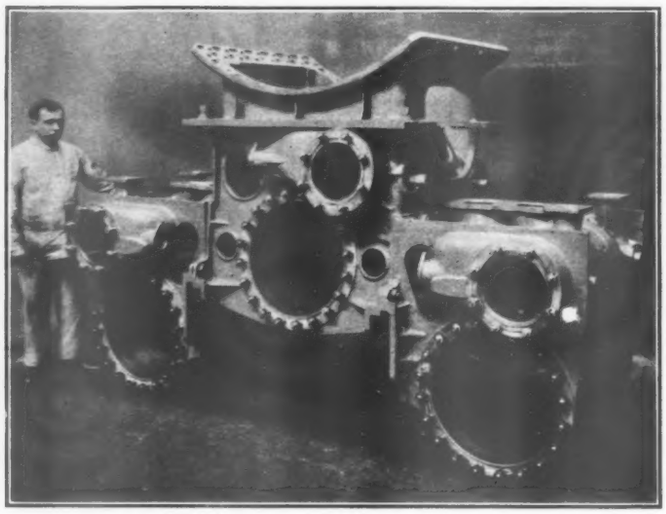


FIG. 4.—CAST-STEEL EXPRESS-LOCOMOTIVE CYLINDER BY SKODA.

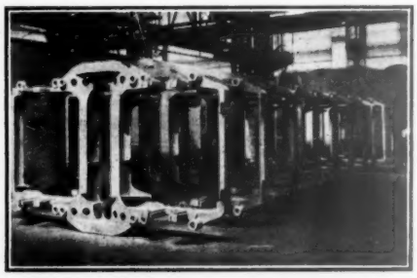


FIG. 5.—CHASSIS CASTINGS FOR DIESEL-ENGINE LORRIES, BY SKODA.

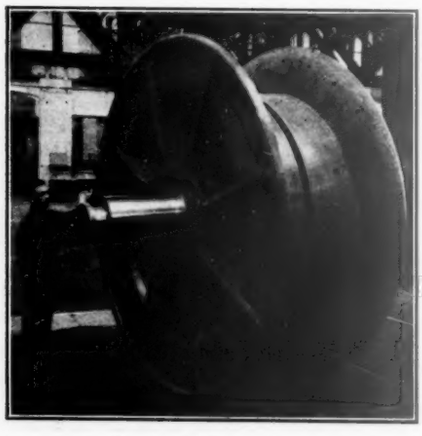


FIG. 6. — MANGANESE-STEEL DRUM CASTING, IN TWO PARTS, WITH FORGED STEEL SHAFT, BY SKODA.

Foundries producing malleable iron are working at full capacity, and their output has exceeded that of 1929.

The steel foundries are also working at nearly full capacity, but delays in delivery are being brought about through the rolling mills breaking their promises, which obviously holds up machine construction.

Last year showed a further development of the export of large steel castings, such as special castings for the shipbuilding industry. The largest casting of this kind was made by the Skoda Works. It is a propeller bracket in two parts, with a connecting piece. The weight of each bracket was 62 tons, and that of the connecting piece 35 tons. It is shown in Fig. 3.

Great improvements have been made in the production of thin-walled castings, as is shown in Fig. 4, which illustrates a cast cylinder for an express locomotive made of carbon steel. A second example is shown in Fig. 5, which illustrates the chassis castings for Diesel engine driven lorries. All these castings were made by the Skoda Works. This works has recently brought the production of manganese steel to a high state of perfection. An interesting example of this is a drum casting made in two parts and carrying a forged shaft (Fig. 6). The weight of this casting is 9 tons. It is worth mentioning that all holes shown in this casting have been drilled. Another interesting item is the special steel cylinder castings for cane sugar mills (Fig. 7).

Brass and aluminium foundries have also worked at full capacity and have exceeded the output of the year 1929. The largest brass foundry, that of Ceskomoravská-Kolben-Danek at Prague, has been equipped for continuous work. It is illustrated in Fig. 8.

Price Changes

Last year was a period of extreme variation in the prices of foundry raw materials, which in general followed the trend of the international market. At the beginning of the year, the increased price level of pig-iron, steel and scrap brought about an increasing demand, and a temporary shortage of some raw materials. These conditions created a notable price improvement of pig-iron, foundry and steel scrap and of non-ferrous metals.

The prices of non-ferrous metals, following the trend of the world market, have decreased in the second half of the year, but the prices of pig-iron and scrap have maintained their now high level. The price per ton of No. 1 pig on January 1, 1937, was Kc. 630,* and is now Kc. 802. The corresponding figures for No. 3 are Kc. 610 and Kc. 787. Similarly, the price of foundry scrap has risen from Kc. 310 to Kc. 720. The increased cost of foundry and steel scrap is considerable, because the price depends entirely on the foreign market.

The price of coal, coke and foundry coke has not changed, and remains the same as the last year, the price for a ton of foundry coke being of the order of Kc. 300.

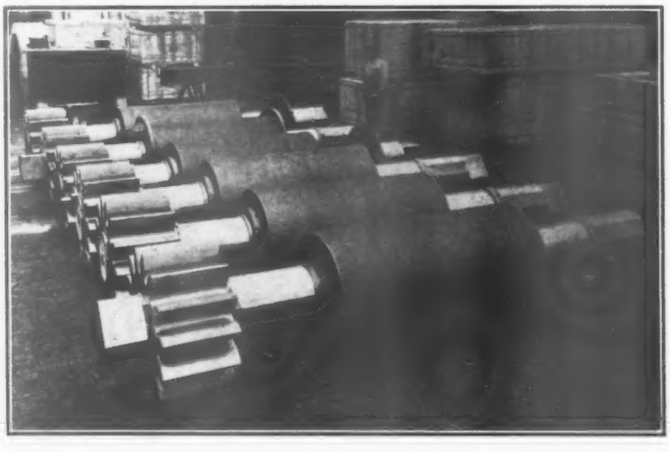


FIG. 7.—CAST-STEEL CYLINDERS FOR CANE-SUGAR MILLS, BY SKODA.

* The present rate of exchange is Kc. 142 = £1.

The selling prices of all kinds of castings hardened, but insufficiently so. There are still a number of the smaller foundries which offer low prices. The negotiations for the initiation of an agreement as to selling prices, which opened in 1936, are still in progress.

In Moravia, however, the Union of Foundries was brought into being, the principal aim of which is to ensure that the market prices of the raw materials, particularly of foundry and steel scrap, are kept within reasonable limits.

The selling prices of grey iron, malleable and steel castings have been increased by 10 and then 20 per cent., brass and bronze castings by 20 and 30 per cent., and those of light alloy castings by 10 per cent.

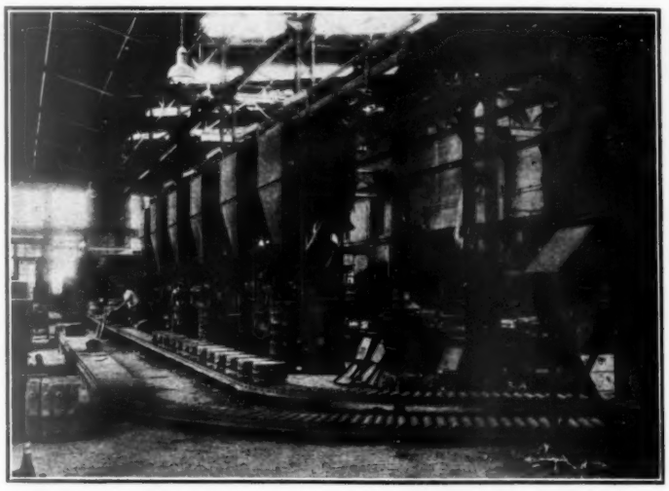


FIG. 8.—CONTINUOUS-CASTING SECTION OF THE NON-FERROUS FOUNDRY OF CESKOMORAVSKÁ-KOLBEN-DANEK, PRAGUE.

The rates of foundry craftsmen remained at the same level as in 1936, but an improvement in wages, corresponding to the slightly increased cost of living, was made by an *ex-gratia* bonus which was paid out as lump sums to the workers. This financial aid was paid three times during the year in the foundry industry. Thus, in this way wages were increased on the average by 4 to 5 per cent.

Last year was entirely free from labour troubles within the industry. Negotiations for increased wages were on several occasions opened by the Trade Union, but satisfactory conclusions were invariably reached, due to the goodwill shown by both parties. Thanks to the conscientiousness of both parties, and to the submission of claims to arbitration, working conditions have been satisfactorily stabilised.

The workmen are coming more and more to the conception that the employer is not an exploiter, and the manufacturer sees that the workers are not mere hands, but his collaborators and an important unit in the industrial life. The manufacturers have been confirmed in this belief by the serious shortage of skilled men and many of the large works now undertake the training of the workmen, and many of them have excellent workshop-schools for apprentices. There is also a great shortage of skilled foremen, technicians and foundry executives.

On the whole, it may be said that, from the size of the order-books and presuming there are no unforeseen events abroad, the present favourable state of activity of the Czecho-Slovakian foundry industry will at least last up to the middle of 1938.

The Polish Foundry Industry and the 1938 International Foundry Congress

By K. GIERDZIEJEWSKI (President of the Technical Association of Polish Foundrymen and of the Foundry Group of the Polish Metallurgical Industry Federation)

THE author gladly accepted the kind invitation of the Editor to prepare an article dealing with the conditions of the Polish foundry industry. He did it all the more willingly as this year is connected with an important event in the history of Polish foundrymen—that is, the International Foundry Congress to be held in Warsaw next September. This will not only be a severe test of the possibilities of organisation of the Polish Foundrymen's Associations, but also of national, technical and scientific aspirations.

The past two years have been marked by a general improvement in industry, which, of course, had its repercussions on the foundry trade. This finds expression in increased employment and by larger production of individual firms. In consequence, the growth of production is represented, in comparison with the last year,* by the following figures:—In 1935 the production was more than 110,000 tons; in 1936 this was about 40 per cent. higher, *i.e.*, about 155,000 tons. Early figures for 1937 show that the year will bring a further rise, which in the first quarter of the year was about 15 per cent. higher than at the same period in 1936, and in the second and third quarters of the year was 50 per cent. greater than the production in 1936. Basing opinion upon these preliminary calculations it is possible to say that the rise in the production of iron in 1937 will be of the order of 30 to 40 per cent. higher than in 1936.

This increase in foundry production, expressed by greater tonnage, and showing the betterment of conditions, has made possible more intensive work on the improvement of the Polish foundry industry.

MR. K. GIERDZIEJEWSKI.

The two co-operating Polish foundrymen's associations are the Foundry Group, a commercial organisation, and the Technical Association of Polish Foundrymen, a purely technical organisation.

The two bodies desire to take the opportunity afforded by the present conditions to perfect the work on the economic and scientific development of the Polish foundry industry. These organisations, working under the direction of the author—which permits a rational division of the work according to their possibilities—tackle the whole problems of the foundry industry.

The "Foundry Group" is an organisation undertaking the direction of the economic activities of the Polish foundry industry, and includes all the most important firms. About 70 per cent. of the general Polish production is embraced in the production of those foundries belonging to the Group. This well illustrates the influence of the Group. However, not only big firms belong to the Foundry Group. It takes care also of small jobbing shops, thus creating, by methods of rational economy, a higher technical level.

The rationalisation of internal foundry work, leading to the improvement of the production in respect to variety and technical value, the incidence of economic possibilities of production, and the help given by the various Government departments are all indicative of the directions of the activity of the Group.

The Foundry Circle of the Association of Polish Technicians was transformed last year into the Technical Association of Polish Foundrymen, referred to earlier.

The Foundry Circle, being an association for

* See FOUNDRY TRADE JOURNAL, January 21, 1937, p. 78.

chartered engineers left outside, then organised all Polish foundry technicians, not graduates of the technical high schools. This involved the loss for the foundry industry of many of the practical men who were left without an association which could give them not only professional assistance and necessary technical information, but also could present to them in a scientific but easy way the most important innovations in the foundry industry. The Technical Association of Polish Foundrymen undertook the solution of technical and scientific problems. Neither lowering its scientific objects, such as the helping of Polish foundry scientists, and being in contact with foreign associations, the Association also organises public lectures, Papers, etc., whilst keeping down to the level of understanding of all foundrymen. The headquarters of the Association are at the foundry laboratory of the Polytechnic High School of Warsaw. This is a guarantee that its work has a proper background. From this scientific centre knowledge is disseminated for the help of the day-to-day creative work of foundrymen. Apart from Papers of technical advice for the professional training of foundrymen, the Association supervises the special technical schools for foundrymen devoted to the training of skilled workmen.

With the creation of the Association there came into being the publication of the journal "Przeglad Odlewniczy." This is the joint organ of the Foundry Group and the Technical Association. The most prominent foundry scientists are collaborating with this organ, which makes propaganda for Polish views on the foundry industry in Poland as well as abroad. A large section of it is devoted to foreign foundry industrial developments, and acts as a link between the various foundry associations and Poland.

FIG. 1.—PRINCE POUIATOWSKI'S MONUMENT AND THE TOMB OF THE UNKNOWN WARRIOR IN WARSAW.

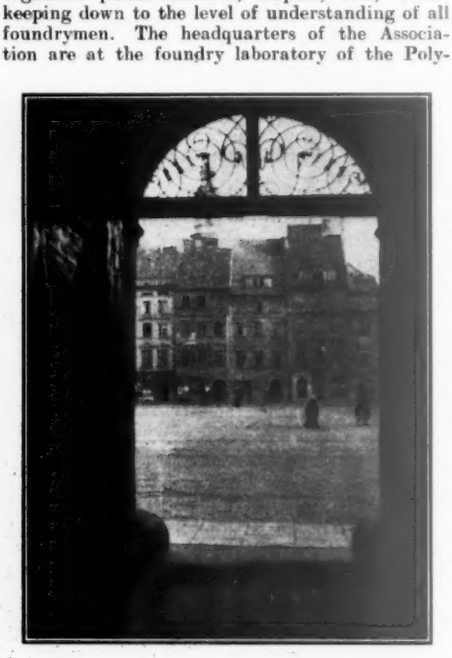


FIG. 2.—COURTYARD OF THE OLD TOWN OF WARSAW.

This Year's Conference

The International Foundry Congress to be held in Poland between September 8 and 17, under the patronage of the President of Poland, will endeavour to enlighten the foundrymen of the world, not only upon latest developments in foundry science, but also on Polish accomplishments in the foundry technology, Polish foundry industry, and finally, with Polish architecture, monuments and the beauty of Polish countryside.

The most prominent representatives of Polish scientific and technical life have promised their collaboration with the work of the Congress, the main theme of which will be "Co-operation between the designer and the foundryman, and its influence on foundry efficiency."

Plans for the Conference

The Conference is to open in Warsaw, the capital of Poland, and from there the visitors will be taken to Kracow, passing *en route* some of the most industrialised and also the most picturesque districts. At Kracow the Conference will come to an end. The excursions have been arranged so as to include the best of Polish industrial establishments and the country's most beautiful scenery. Warsaw is certainly one of the most interesting cities in Europe. It has an ancient feudal castle which was once the residence of the Kings of Poland, and is now the home of its Presidents. From both the economic and cultural aspects the city presente features of outstanding interest. Its monuments and public buildings express the highly developed art of the district, and Fig. 1 shows a typical example. The geographical position of Warsaw is in truth the centre of Europe. Since the emancipation of Poland, Warsaw has grown enormously, and like other big cities now embraces in suburbs all the surrounding villages, but that the centre of the old town is scarcely touched by the passage of time is shown in Fig. 2. Three days are to be spent in Warsaw, when the members will leave for Katowice (Kattowitz) in Polish Silesia. This town, reminiscent of an American one, is the centre of the mining and metallurgical industries. From here a detour of the centre of Poland—the "Kieleckie"—will be made for the purpose of visiting various large foundries making builders' and consumer castings on a large scale. From here the party will visit the Krakowskie region in order to inspect the large foundry attached to the Wegierska Górka plant, passing *en route* the summer residence of the President, which is located at Wisla. This house is beautifully situated, yet is quite close to an important metallurgical centre.

FIG. 3.—ONE OF THE LAKES SURROUNDED BY THE TATRA MOUNTAINS.

As no person visiting Poland must miss seeing the Tatra mountains, a section of the Carpathians quite close to the Czecho-Slovakian frontier, it has been decided to include an excursion to Zakopane. This town is esteemed to be one of the most beautiful spas in Europe. It is magnificently situated amongst the foot hills of the Tatra mountains (Fig. 3). There are several beautiful mountain lakes lying amongst some of the wildest scenery Europe possesses. A visit to these is to be included, and the excursion will be enhanced by seeing the peasant costumes, justly ranked amongst the most picturesque in Eastern Europe. Moreover, arrangements have been made to hear some of the local folk songs, the music of which unquestionably inspired some of the great national composers—Szymanowski and Moniuszko.

FIG. 4.—A SCENE IN ANCIENT KRACOW—THE JAGIELLANSKA-TARRU LIBRARY.

(*Concluded on page* 72.)

The Russian Foundry Industry

By VICTOR M. SHESTOPAL (Member of the Editorial Board of "Liteinoe Delo")

THE foundry industry which the Soviet Union took over from the Tsarist *régime* was poorly developed, as is evidenced by the fact that, just prior to the revolution, the annual production of iron castings amounted to 400,000 tons; steel castings 60,000 tons, and malleable iron 15,000 tons. These castings were, for the most part, of the type used for construction, building details and household utensils, and only a small quantity was of the type needed for agricultural machinery. The production of castings for turbines, Diesel engines and machine tools was not undertaken until comparatively recently.

With the rise in the whole Soviet Union national economy, and especially during the periods of the first and second Five Year Plans, the foundry industry of the U.S.S.R. became unrecognisable. If in 1927 the average production of castings did not greatly exceed the pre-revolution figure, by 1937 the figure for foundry production has reached approximately 5,000,000 tons of castings per year—a tenfold increase.*

The whole aspect of the foundry industry of the Soviet Union has completely changed. There have appeared completely mechanised foundries in the motor-vehicle and tractor plants and huge modern shops for production of heavy machinery castings; while new technical processes, such as the Griffin wheel, die-castings, and production of castings in stainless steel, etc., have been established.

Large New Plants

Among the most important new concerns are the cast-iron and steel foundries of the Ordjonikidze (Ural) and Stalin (New Kramatorsk) heavy machine-building plants, the Drepropetrovsk metallurgical equipment plant and the conveyorised mass-production foundries of the Chelyabinsk, Kharkov, Stalingrad, Moscow, Gorky and Kirov auto-tractor plants. The large-scale mechanised steel foundries of the car building plants in the Ural and Ordjonikidregrad have no superiors anywhere in the world. The locomotive foundries in Voroshilovgrad and Kolomna, foundries for alloy steel castings in the Moscow "Hammer and Sickle" plant and the Leningrad metallurgical plant are equipped exclusively with high-frequency induction furnaces. The Moscow, Leningrad, and Tbilissi plants for machine tool castings, the malleable iron foundry for pipe fittings in Leningrad, the mechanised steel and iron foundry shops at the Rostov agricultural machinery plant, Lyuberetsky and Siberia plants, and foundries which produce special castings for auto-tractor spare parts, etc., are other notable units.

During the first five year plan a sum of 600,000,000 roubles was invested in the construction and reconstruction of foundry shops. This construction of new shops and reconstruction of old ones brought about a significant increase in the average output per foundry. Twenty per cent. of the shops produced over 10,000 tons each in 1936. Cast-iron machine building foundries averaged 8,500 tons each; steel casting foundries, 10,500 tons, and malleable iron foundries, 8,000 tons.

In order to realise the full significance of these figures it is sufficient to mention that in the United States in 1929, the peak year, the average production per cast-iron foundry only slightly exceeded 2,000 tons; and for each steel foundry 7,000 tons. The U.S.S.R. has taken first place in Europe for the proportion of higher grade castings produced; of the total output, the figures being 21.6 per cent. steel castings and 4.2 per cent. malleable iron castings. These figures are considerably higher than, for example, those of Germany, where 10.3 per cent. of the total castings are steel and 2.9 per cent. malleable iron.

Quality Amelioration

As the volume of Russian foundry production has increased, the quality of castings has steadily improved also, while the establishment of numerous laboratories has made it possible to satisfy

MR. VICTOR M. SHESTOPAL.

demands for great accuracy and uniformity in chemical analysis and microstructure. Until 1927 the requisite tensile strength was 30 kg. per sq. mm., with an elongation of 3 or 4 per cent. By 1929, however, the tensile strength of malleable iron had increased to 35 kg. per sq. mm., with an elongation of 6 per cent. In 1932 the minimum elongation had become 12 per cent., and recently the requisite standard for elongation of malleable iron was set at 18 per cent.

Resistance to strain, the best indication of the mechanical properties of iron castings, had an upper limit of only 25 kg. per sq. mm. in 1929; in 1932 it had risen to 30 kg. per sq. mm.; in 1934 it was 40; and in 1937 tensile strength of cast iron reached 48 kg. per sq. mm. The tensile strength required for steel castings for rolling stock, unit-cast locomotive frames, car wheels, etc., is from 40 to 55 kg. per sq. mm.

At the same time, the range of cast steels has greatly increased. The Ordjonikidze Machine Building Plant (Ural) alone specifies more than 40 types of highly complicated steels, including chromium-nickel-tungsten, molybdenum, vanadium and other exceedingly complex varieties for the most varied purposes, with tensile strengths exceeding 110 kg. per sq. mm.

Upon the installation of improved technical equipment and introduction of modern technological processes, productivity of labour also increased, as is evidenced by the increase in castings per worker and output per square metre of moulding floor. In 1936 the average production of good castings per worker in the engine building industry was 25.6 tons for cast iron, 13.2 tons for steel, and 9.7 tons for malleable iron castings. In the same year, the average output of iron and steel castings per sq. m. of floor space was 8.9 tons.

For the various branches of machine building, these figures are as follow:—

Industry.	Output per sq. m. of floor space in tons per year.		Production per moulder in tons per year.	
	Cast iron	Steel.	Cast iron.	Steel.
Heavy machine building ..	10.1	5.9	33.0	10.9
Machine tools ..	9.6	—	13.1	—
Wagon and locomotive building	8.3	15.4	26.1	12.3
Diesel construction	7.2	8.4	19.6	18.8
Armature production	7.1	2.7	28.8	9.3
Agricultural machinery ..	8.7	—	21.0	12.1
Auto-tractor building	20.2	14.3	35.9	—
Textile machinery	7.8	—	19.2	—

Foundry Equipment

As foundry production has developed, the foundry supply industry has also expanded. The supply of plants with moulding sand is concentrated in the hands of a trust especially established for this purpose in 1930. The past year has seen over 1 million tons of sand dug for supplying the larger engine building shops alone, and within the next few years this amount will be tripled. Rich deposits of bentonite, equally colloid to the American one, have been found in Central Asia, and the pits put in operation last year assure the industry a steady supply of this material. At the same time, however, to reduce the need for fresh sand, reclamation processes are being extensively introduced.

The above-mentioned trust has also a large factory for the manufacture of all types of apparatus for control of and research on moulding materials. The foundry machines are being built chiefly by the "Krasnaya Presnya" Plant in Moscow, which produce various types of moulding machines. This plant is now arranging to produce machines in graduated series varying in capacity, of original Russian design.

At the same time, the Auto Tractor Scientific Research Institute is constructing a high-production automatic machine for centrifugal casting of 180-200 tractor sleeves per hour, while the Central Machine Building Institute of Scientific Research has obtained very favourable results from an original centrifugal pipe-casting machine.

In order to satisfy the growing demands of industry, the production of castings will be raised to 7,500,000 tons per year by 1942 an increase of 75 per cent. over the present figure. To produce a similar increase in the mechanisation of processes, it will be necessary to install foundry equipment costing 165,000,000 roubles. A second foundry equipment plant, therefore, is being constructed. Here will also be concentrated the building of melting and other furnaces, with the exception of the electric types which are supplied in ample quantity by the electrical equipment plant.

Pattern Production

Besides the second foundry equipment plant, this year work is to begin on a special plant

* According to the plan for 1937, foundry departments of the heavy-industry machine building plants alone were to produce 2,215,000 tons of castings, of which 1,548,000 tons were to be of iron, 550,000 tons of steel and 117,000 tons of malleable iron.

for metal patterns. At the present time there are a number of modern pattern shops in motor-vehicle, tractor and other plants, but the progress of machine building, depending as it does upon frequent change in types of machines, points to the path of American experience, i.e., leaving to the pattern shops of machine building plants repair and duplication, while concentrating production of new series in establishments specialising in this branch of work. Availing itself of the advantage of a single industrial administration, the central pattern plant will be able to serve as a guide and leader in the direction of standardisation and co-operation between foundries.

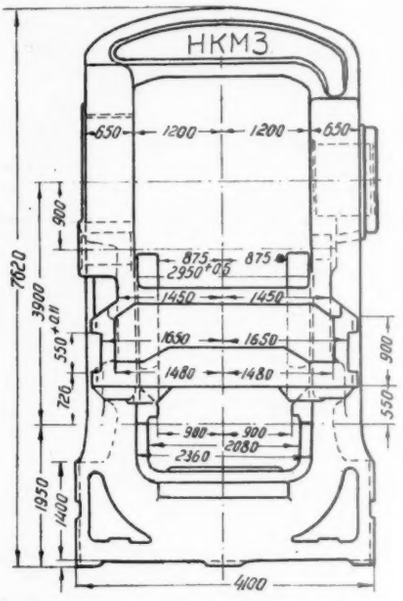


FIG. 1.—FRONT ELEVATION OF 125-TON CAST-STEEL HOUSING FOR SLAB SHEARS.

A Large Steel Casting

At the present time there is no casting which is not made, or cannot be made, in Russian plants. For example, one of the most complicated of castings made is that of a steel housing for shears for cutting 150 × 1,500 mm. slabs, produced by the Stalin Machine Building Plant (New Kramatorsk). This is shown in Figs. 1 to 3.

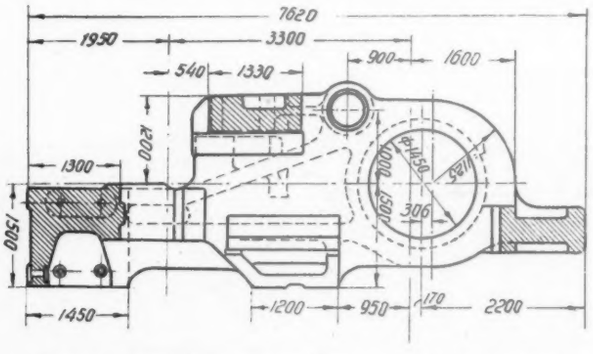


FIG. 2.—SIDE ELEVATION OF HOUSING FOR SLAB SHEARS.

The general construction of the housing consists of two vertical columns with powerful crossbars across the upper and central parts for directing the movement of the head. The upper part of each column has a large recess for a hub of the crank shaft. The whole casting requires 200 tons of liquid metal, and the finished weight of the housing is 125 tons, while the walls are from 200 to 800 mm. thick.

Fig. 3 shows the method of moulding. A specially made pit 9 by 6 m. with a depth of 4 m. was lined at the bottom and sides with steel bars. The moulding sand had a green permeability of 95 cm. per min., and a dry permeability of 120 cm. per min., while the compression strength was: *Green* 0.56 and *dry* 3.3 kg. per sq. cm.

The metal was prepared in two 80-ton basic open-hearth furnaces. One 35-ton open-hearth furnace and one 10-ton electric furnace were held in reserve. The casting was effected from one 100-ton and two 50-ton ladles. The temperature of the steel in the furnace tap was between 1,620 and 1,640 deg. C., and in the ladle at pouring 1,480 and 1,500 deg. C. The first addition of metal (10 tons) was made after 3 hrs., the second after 6 hrs., and the third after 9 hrs. The analysis of the metal was as follows:—C, 0.21 to 0.27; Si, 0.30 to 0.32; Mn, 0.56 to 0.64; S, 0.023 to 0.039; and P, 0.25 to 0.33 per cent.* The mechanical properties were:—Tensile strength, 48.8 to 49.3 kg. per mm.², and elongation, 24.8 to 25.1 per cent.

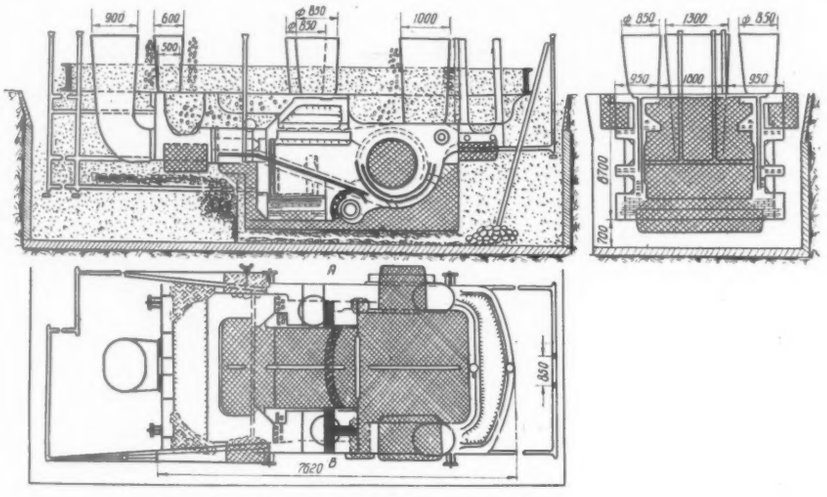


FIG. 3.—METHOD OF MOULDING THE HOUSING.

The casting was cooled in the sand for 27 days, after which it was heat-treated by double annealing with a slow process of heating and cooling. The first heating took place at the speed of 10 deg. per min. up to 900 deg. C., at which temperature the casting was held for 40 hrs., followed by cooling at the same rate to 300 deg. C. The second heating was at the rate of 13 deg. per min. to 850 deg. C., held for 20 hrs., and then allowed to cool completely in the furnace.

The duration of the whole process, from the moment the order was received, took 103 days, with the time allocated as follows: 11 days for preparation of the mould, 5 days for drying, 7 days for assembling, 33 days for cooling, and 14 days for heat treatment.

* It is suggested that this may be 0.025 to 0.033 per cent.—Editor.

Rolling and Pressing Cast Iron

To advance the development of the foundry industry from all angles, scientific research institutes are working hand in hand with plant practice on foundry problems. One of the most outstanding examples is a new method of producing cast-iron components developed by Prof. Ulitovsky by rolling and forging cast iron.

In general this method consists in melting and superheating cast-iron charges in an electro-magnetic field of high-frequency. The liquid cast iron is then poured out on to rollers revolving in opposite directions, the space between the rollers being determined by the thickness of the sheet to be produced. This also depends upon a number of factors, such as the temperature of the metal, its chemical composition, the speed at which the rollers revolve, etc. After rolling the sheet is treated at a temperature of 850 deg. C., after which it becomes soft and can be bent, or, in other words, becomes "malleable," and is then pressed.

This method was tested out at the Leningrad Institute of Applied Physics, and the apparatus used there produced sheets from 0.3 to 0.8 mm. thick. The purposes to which the resulting product may be adapted are most varied, and the results indicated are highly promising. At the present time one of the largest plants in Russia is installing the production equipment and constructing a special press for the forming of cast-iron components, utilising Prof. Ulitovsky's method.

Better Quality Needed

The most important task facing Russian foundrymen to-day is that of improving the quality and increasing the mechanical properties of all types of castings. So far as cast iron is concerned it involves the extensive use of Khalilovsky, Elisabethian and other natural iron alloys, which surpass in quality even the well-known special American pig-irons. The enormous deposits of naturally alloyed irons, including those containing titanium, vanadium and other elements, predict a great future for the Russian foundry industry through their application.

Labour Organisation

The foundry industry employs more than 150,000 people, all of whom are organised in the appropriate branches of the Trade Unions. Foundry engineers and technicians are also affiliated to the Scientific Technical Society for Foundrymen, which includes in its membership more than 1,500 subscribers. The Society publishes a magazine, "Liteinoe Delo" (Foundry Industry), has numerous committees dealing with grey iron, steel, moulding materials, equipment, etc., and takes an active part in development of the foundry industry of the country.

The Leading Manufacturers
The Oldest Established....
The Most Reliable....

CUMMING'S CFF FOUNDRY FACINGS

COAL DUST
Superlatively Regular in Grist. Superior in Quality.
Seven Grists Standardised.

FOUNDRY BLACKINGS
For all Purposes. The Best on the Market.
Manufactured by the New Process.

CUMMING'S CPP PARTING POWDER

BRITISH PLUMBAGOS
Imported Direct. No Continental Adulteration.

POWDERED CORE GUM
British Manufacture. Best Quality.

CUMMING'S CRIC RELIABLE IRON CEMENT

CUMMING FURNACE
Users of the "Cumming" Furnace are Increasing Week by Week.

THE CUMMING HAND RAM MOULDING MACHINE
THE CUMMING SAND MIXER
CORE COMPOUNDS • PARTINGS
CUMMINGSTONE • REQUISITES

CUMMING'S CCC CORE COMPOUND

All our own manufacture

FOUNDRY FACINGS MANUFACTURERS
•
GENERAL FOUNDRY FURNISHERS
•
ESTABLISHED 1840

WM CUMMING
AND COMPANY LIMITED

Head Office & Works.....
KELVINVALE MILLS, MARYHILL, GLASGOW.
BRANCHES AT :- FALKIRK · CHESTERFIELD · DEEPFIELDS AND MIDDLESBROUGH...
LONDON OFFICE :- SENTINEL HOUSE, SOUTHAMPTON ROW, W.C.I.

The Italian Foundry Industry

By Dr.-ING. GUIDO VANZETTI

THE self-sufficiency scheme inaugurated by the Italian industrial organisations in 1935-36, during the Sanctions, in quite special circumstances which compelled solutions of an urgent nature to be found, often even hastily, has been objectively reviewed and settled in 1937 under entirely different conditions, and therefore more calmly and deliberately, for all the branches of industry. Even in a review exclusively concerned with the foundry, the author considers it interesting to mention some of the measures taken in connection with the production of raw materials used in the foundry.

Important researches have been undertaken on the subject of natural resources of iron ore. These have been organised on a large scale with liberal advances from the large Italian industrial groups. They have covered new and old deposits which had been neglected in the past. The lean ores are enriched in suitable concentration plants, and sands containing iron, which are comparatively plentiful in Italy, have been bonded with a view of using them in blast furnaces.

Italy is rich in iron sulphides, and blue billy, the residues from the manufacture of sulphuric acid, is largely used in special electric furnaces with gas recuperation. There exists near Milan a large-scale plant equipped with six of these furnaces, having a power of about 48,000 kw., for an output of 80,000 tons per year of excellent pig-iron free from sulphur.

There are now 14 coke-fired blast furnaces, having an annual output of 800,000 tons, operating in Italy. These furnaces are in course of improvement so as considerably to reduce the coke consumption and to equip them with the latest subsidiary plant. The erection of a new integrated steelworks in the neighbourhood of Genoa is also being planned; the pig-iron produced in the blast furnaces will be transformed into steel by the basic-Bessemer process.

DR.-ING. GUIDO VANZETTI.

With a view of restricting the consumption of steel scrap, which is mainly imported from abroad, all steelworks must maintain certain proportions in the burden of melting furnaces, according to prescribed regulations relating to the quantity of pig-iron to be used in the charge. These regulations lay down that open-hearth furnaces operating on liquid charges must use 70 per cent. of pig-iron; open hearths operating on cold charges 30 per cent. of pig-iron, and electric furnaces 6 per cent. of pig-iron.

In the production of non-ferrous metals, much progress has been made; new plants have been erected for the production of aluminium, using bauxite from Istria, and for the electrolysis of aluminium. An experimental plant for the study of the process of the extraction of nickel from nickeliferous and cobaltiferous iron sulphides, from deposits existing in Piedmont, has been erected with very satisfactory results. Derelict copper mines in Tuscany have been reopened, whilst for tin the large plants of Monte Valerio are now working with excellent results. The production of magnesium extracted from Italian ore has been developed, so that an increase in the output of the foundries operating on light magnesium alloys is foreseen in the next few years.

Always with a view of reducing imports to a minimum, endeavours are made to utilise in the best possible way the non-ferrous metallic residues in order to obtain therefrom the most important metals (copper, tin, lead, antimony). In the last few months a large plant for recovering copper and tin from low-grade bronze scrap by means of electrolysis has started operations.

TABLE I.—*Production Capacity of the Italian Grey Iron Foundry Industry.*

No. of Foundries.	Individual capacity. Tons per year.
138	50
110	120
157	360
74	700
37	1,200
27	2,500
16	7,000
12	7,000*

* Exceeds.

Reverting to the actual foundry industry, it is possible to state that, at the present time, the capacity of the various plants is amply sufficient to cover the home requirements. One might even say that too many new foundries have been erected lately; every steelworks now has its own foundry department; some large engineering works, in order to make themselves independent at a time when, owing to the restrictions then prevailing in connection with raw materials, the Italian foundries were not in a position to supply them sufficiently rapidly, erected their own foundries. The existing foundries, possessing years of experience, have therefore directed their attention to the production of alloy steel and alloy cast iron.

More than 30 steel foundries are now operating in Italy to produce less than 80,000 tons of castings, which output had been forecast for 1937. Furthermore, there exists a very large

(*Concluded on page 72.*)

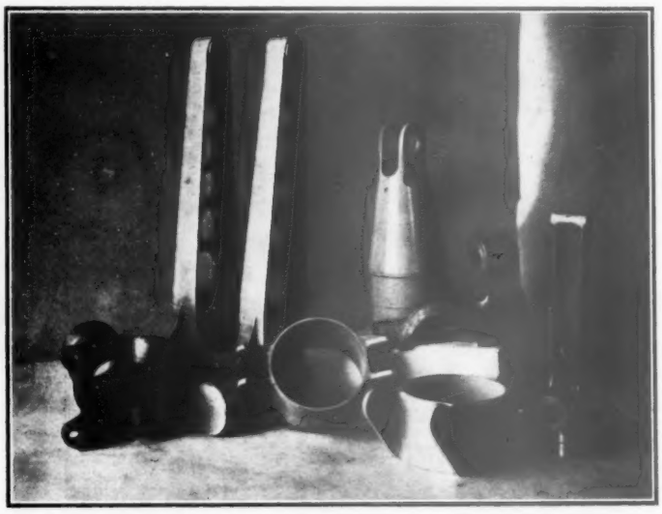


FIG. 1.—A VARIETY OF CASTINGS IN CHROMIUM-MOLYBDENUM STEEL, BY THE FONDERIA MILANESE DI ACCIAIO VANZETTI.

FIG. 2.—CAST CR-MO STEEL ANTI-SKID DEVICE ATTACHED TO LORRY WHEEL.

With all these new plants the steel output in Italy could be raised from 2,000,000 tons to 2,500,000 tons per year, and the proportion of steel produced from the ore, as distinct from that produced from scrap, would be appreciably increased. It is interesting that the quantity of steel produced by electric furnaces in recent years has attained 30 per cent. of the total output.

SAND PLANT

ROTARY SCREEN
(Covers removed)

CENTRE SHAFT TYPE

CAPACITY 60 tons per hour

with

MAGNETIC BELT CONVEYOR

and

OUTLETS for DESILTING PLANT

SPECIALISTS

Send your enquiries for any FOUNDRY MECHANISATION to the makers:—

GOCGON FOUNDRY EQUIPMENT
LIMITED
OVENDEN
HALIFAX

'Phone: 2423.
'Grams: Coggon.

WARNER Special PIG IRONS

- Warner C.B.R. and Low Carbon Cylinder
  (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- Low Carbon Malleable
  (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

- **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

- **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO. LTD
CARGO FLEET MIDDLESBROUGH

The South African Foundry Industry

By T. NIMMO DEWAR (President of the South African Branch of the Institute of British Foundrymen)

FOR many years the FOUNDRY TRADE JOURNAL has worthily represented the industry from which it takes its name. It is therefore a great personal pleasure to use this medium to enable the South African Branch of the Institute of British Foundrymen to send greetings to its many friends in Britain. The members have but recently joined the family who comprise that important Institute, but we all realise already the invaluable work that is being done and we hope to co-operate with you all in further progress in this Union of South Africa. While the Branch has been constituted scarcely nine months, the foundry trade in this country can be said to be as old as the Witwatersrand gold mining industry. Fully fifty years ago foundries were first set up in the then infant mining camp of Johannesburg. They assisted in servicing the mines with their elementary requirements. It is a pleasure to observe that some of these pioneer foundries have grown so extensively that they are amongst the leading workshops of the Union.

Factors in National Growth

While it is clear that our local industry is very small compared with the parent industry in Britain, yet its progress has been remarkable. In reviewing that growth it may be said that the first phase was a time of building up parallel to the progress of the Witwatersrand prior to the Great War. The second period started with and continued more and more intensively during the war when South Africa was largely cut off from her main sources of supply. The local foundries had to perform veritable miracles to keep the wheels of industry turning.

Up to this point progress was very satisfactory, and around 1922 the establishment of foundry work on a permanent basis was fully accomplished. The later post-war years did not see much advancement and the third phase ended in 1933, when Britain went off the gold standard.

In the most recent growth dating from that time three factors have combined to make the progress outstanding in local foundry work. They can be enumerated briefly as follows:—

(1) The enhanced value of gold with the almost incredible intensive mining development which has arisen from it.

(2) The manufacture of a satisfactory supply of pig-iron in the entirely modern plant at Pretoria.

(3) The pressure on British foundries to meet their own national requirements, thereby eliminating in great measure overseas competition in so far as it can concern the local industry.

MR. T. NIMMO DEWAR.

Even a cursory glance would make it clear to anyone that the growth and present prosperity of the Union of South Africa has been created and maintained by the great gold mining industry of the Witwatersrand. In the early days, of course, diamonds played an important part in pressing forward national progress. Yet to-day the manufacture of the products of iron and steel seems destined further to broaden the base on which future advancement will be made.

New Developments

The up-to-date plant at Pretoria proves the interest shown by the State in the welfare of that key industry of which we form a part. But base metals are also coming into their own. Helped by the co-operation of the Development Board in the Union and in London, steps are being taken to locate and mine the various ores. The making of ferro-alloys is being fully investigated.

With the necessary supply of coke and refractories of excellent quality available, the Union bids fair to become more and more self-contained from a metallurgical point of view. In these disturbing days, when various nations are arming for a possible conflict, it must be a source of satisfaction that one of the younger members of the British Commonwealth of Nations is putting its house in order so as to cope with its essential requirements in times of peace or war.

Great Britain, the mother of these nations, has played a noble part in developing industries of which the foundries can be taken as one example. These industries make for stability in times of national stress, and we in South Africa are glad to do our part for the common good.

Concluding on a more domestic note, I would say the local Branch of the Institute has in hand a considerable programme for 1938. It is proposed to give diplomas for the best Papers submitted on outstanding technical practice. An educational committee is being formed to interest the local youths in the prospects of the trade with a view of their apprenticeship in due course. The committee will follow up their acquirement of technical knowledge to the future benefit of the industry not only personally, but as a whole.

The various groups of technical men located on the Witwatersrand and forming the Associated Scientific and Technical Societies of South Africa have held public dinners for many years. It is therefore proposed that the infant Branch of the Institute should follow their example in April. Through the goodwill of some leading speakers, we hope to receive the publicity so necessary and valuable in these days of competitive development.

There is no reason why the foundryman of South Africa should not continue to prosper with the general advancement and national progress, and my fellow members look forward to a year of good cheer. The hope is expressed that similar prosperity may be the lot of our British friends and that the good work the Institute is accomplishing on their behalf will be added to in fullest measure.

The Polish Foundry Industry

(*Concluded from page* 66.)

From Zakopane, the route chosen passes by Pieniny, the home of the Polish National Park, and a district of indescribable beauty.

The last two works to be visited are Moscice, devoted to large-scale production of nitrogen compounds, such as saltpetre, which apart from satisfying the home market, find their way into most foreign countries, including Great Britain. The second works is Wieliczka, an ancient and extremely large salt mine. The underground halls are so big that at certain seasons of the year religious festivals are held there. Around these mines are centred numerous folklore legends.

The final sessions are to be held in Kracow, esteemed by many to rank amongst the most interesting towns in the world. Its beginnings are lost in antiquity, and it retains a real old-world atmosphere (Fig. 4). By many it is still regarded as the cultural centre of Poland.

A very hearty invitation is extended to all British foundrymen to attend this International Conference, and it is hoped that they will not only benefit from the technical side, but will have the satisfaction of visiting an interesting and beautiful country.

As the Conference period is limited, it is thought that it will be possible to obtain for members of the Conference a reduction in railway fares in order that other centres may be visited at low cost.

The Italian Foundry Industry

(*Concluded from page* 70.)

number of grey iron foundries, and their capacity is set out in Table I.

It is estimated that the production of cast iron in 1937 amounted to approximately 400,000 tons. With such a development in production, both in quality and in quantity, it can be stated that the importation of castings has now almost ceased to exist.

In the domain of alloy steels, the author would like to make special reference to some applications of chromium-molybdenum steel castings in fields which, until very recently, were exclusively the sphere of forged steel. An Italian foundry has, for some time past, been undertaking the manufacture of an anti-skid device for lorries in this particular steel. These were used with success in the Abyssinian war. Recently, this foundry has started the manufacture, using the same type of alloy, of castings for aircraft construction, which, of course, must be manufactured with the greatest care and rigorously controlled by microscope and X-ray apparatus. This application of castings, which has been very considerably developed in Germany in the last two years, presents the following advantages as compared to forged components. In the first place, there is less waste of material, coupled with the possibility of the better adaptation of the shapes of the component to the constructive requirements. Then there is the greater uniformity of the mechanical properties of the metal with and across the main sections, and finally the possibility of easily increasing the output or of modifying the design without entailing too heavy a financial burden. Some of the applications of this new material are shown in Figs. 1 and 2.

CLEAN IRON
SAVES COKE IN THE CUPOLA

The cleaner iron given by Workington Machine Casting (free from sand fused to the surface) saves fuel in the cupola. A foundry which used Machine Cast Iron reports the following results :

- Coke consumption decreased by 20%
- Slag from the cupola reduced by 45%
- Limestone charged reduced by 50%
- Quantity of iron melted increased by 24%
- Hanging eliminated completely.
- Castings cleaner.
- Metal composition more regular.
- Longer Life of Cupola Lining.

THE UNITED STEEL COMPANIES LTD

Write to The Publicity Department, The United Steel Companies Ltd., 17, Westbourne Road, Sheffield, 10, for Brochure "Machine Cast Iron."

WORKINGTON
MACHINE · CAST · IRONS

WORKINGTON IRON & STEEL COMPANY · WORKINGTON · CUMBERLAND

BRANCH OF THE UNITED STEEL COMPANIES LIMITED

W.33

The Belgian Foundry Industry

By PAUL ROPSY (President, Belgian Foundry Employers' Federation)

Steel Castings

THE industrial situation of Belgian foundries in 1937 has been decidedly satisfactory, a distinct increase in output having allowed manufacturers to reduce their overhead expenses, so that the adverse effect of higher wages and of the big jump in price of materials has reflected only moderately on selling prices.

This smaller increase in the cost of the finished product, as compared with the steady rise (attaining nearly 100 per cent.) of hematite iron and scrap, coupled with the erratic movements in the value of alloys—mainly to be ascribed to political influences—whilst being due primarily to an augmented tonnage, also has causes which may be related to more intrinsic elements. These causes are therefore liable to remain at least partially effective in case of reduced volumes of production. Outstanding amongst these is a more attentive study devoted to all details of manufacturing processes, such as the selection and blending of sands, moulding and coremaking practice, fuel economy in heat-treatments, and more especially the co-ordination of design with moulding with the object of simplifying cleaning and machining operations whilst delivering a neater and better product.

Another aspect of rationalisation has not been forgotten, likely to produce noteworthy savings to users and the nation as a whole: exact appropriation of steel castings to the service expected from them, both from a metallurgical standpoint, where corrosion- and heat-resistance are concerned, and from a point of view of design, the aim being the production of essentially suitable shapes, and the avoidance of the dreaded notch-effect, all of which combine to produce lighter, safer and increased fatigue-proof finished castings.

Some valuable research and experimental work on these lines has been conducted by the most prominent foundries in their own up-to-date laboratories, and in co-operation, for service tests, with the chemical industries, forge and heat-treating plants, glass and refractory works, and several railway companies. Ordnance castings, since existing conditions oblige nations to indulge in large scale steel consumption to this end, have also received due consideration.

Large quantities of cast steel have been supplied for new railway material being built in Belgium and abroad for national and overseas use. Noteworthy examples include one-piece truck frames for the big 8,300 gallon tenders for the newest Belgian State Pacific type locomotives; bogie frames for all-steel passenger stock, and freight bogies composed of cast-steel bolsters and cast-steel side-frames incorporating integral boxes for S.K.F. roller bearings, destined for Brazil. Great improvements have been attained in this line by thorough extensometric strain determination and the resultant better adaptation of girder sections to real stresses.

A pretty brisk trade, though not so important from a tonnage point of view, was experienced in special alloy steels, rustless and anti-oxidising, and high-chrome, for the chemical industries; high-grade nickel-chrome steels for traction gear blanks and general use; and particularly air-hardening steels for crushing machinery and railway permanent-way accessories, points, crossings, etc., where the 12 to 14 per cent. manganese steel has also been popular.

In brief, 1937 has given the Belgian steel casting industry a period of good activity and steady developments, which allow well-organised foundries to look forward confidently to the coming year.

Malleable Cast Iron

In this section of the industry much better trading conditions were experienced in 1937. The foundries have worked to about 80 per cent. of their production capacity, but prices have been very low and have been insufficiently augmented since the end of 1936. The steep rise in the cost of all raw materials, and the continuous increase in wages, have, in spite of generally satisfactory order-books, combined to yield for the various works profits of small dimensions.

Amongst the numerous technical advances made by this section of the industry in general are the establishment of an intense scientific control and the widespread use of the rotary furnace as a melting plant.

Non-Ferrous Foundries

No statistics relative to the production of non-ferrous foundries are available, and it is difficult to obtain a general appreciation, but it can safely be said that during 1937 the brass and light-alloy foundries very considerably increased their output in comparison with the last few years. The tonnage manufactured has certainly reached the average of the good years before the depression of 1930.

Good progress has been registered by the foremost foundries. In the field of light alloys, one foundry has installed an electric furnace for the heat-treatment of castings, previously non-existent in Belgium. The chill-casting of bars and bushes by the brass foundries has made noteworthy progress, whilst new refining processes have helped materially to improve the product of a number of the Belgian non-ferrous firms.

Stove-Grate Foundries

Whilst boom conditions were not experienced by the Belgian foundries making cookers, grates and other heating apparatus, yet satisfactory progress was registered. Production has not been materially increased, but prices have been increased to yield reasonable economic return, though they have not always been adhered to. The retail prices have shown no tendency to be lowered.

The end of the year 1937 has shown a slight tendency towards easiness, which cannot be entirely attributed to the normal seasonal decline.

Conclusion

The year 1937 must have produced several tales of individual records, including the surmounting in many cases of difficulties undreamed of even in the war years, although bringing to manufacturers little added profit for the extra output. The anxiety, worry and strain on all must have left a mark which it is hoped 1938 will do much to remove, even should it only bring back that sanity required both by our own trade and throughout the world. Given that the present slowness of trade will disappear and ironfounders can look forward to a bright 1938.

The Light Castings Industry

(*Concluded from page* 46.)

cooker. The demand in 1937 must have created a record and shows little sign of diminishing. Self-setting cookers are gaining in popularity and heat storage cookers are growing in demand every year with output steadily increasing.

Gas cookers have had a good year with a slight tapering-off of orders towards the end, and the same can be said of electric cookers. Manufacturers are striving hard to meet public demand for improved cookers, and new types and designs are regularly appearing on the market.

Heating Stoves.—Cast iron has had a bad setback in recent years in this class, but new types of cast-iron coal-burning stoves are now beginning to appear on the market. A large and influential committee is also in operation studying the question of the open fire, and ironfounders are giving this body much support. Gas fires are maintaining their position on the market, and some of the new designs have become worthily popular.

Rain-Water and Soil Pipes and Gutters.—This large section has found 1937 a good year for orders, and although it will be a month before definite returns are available indications point to a decided increase over 1936. The "B.I.A. Melton" patent ear is increasing in popularity, and soon should become universal practice.

Miscellaneous Builders' Castings.—Orders have been well maintained.

United Steel Companies, Limited

Mr. Robert Crichton, the director of the United Steel Companies, Limited, in charge of the Workington Iron and Steel Branch, who has held that position since June 1, 1929, resigned on December 31.

Mr. Crichton's intention of retiring was previously announced. In the eight and a half years which he has spent at Workington he has instilled new life into this part of Cumberland. Many improvements have been made in the properties committed to his charge, and many of them have been modernised. He has taken a great interest not only in those who worked for him, but also in the industrial welfare of the whole neighbourhood. He will be greatly missed by his colleagues and by all who have worked under him at Workington.

In future the Cumberland branches of the United Steel Companies, Limited, will be administered by a local board of directors, and the name of the Workington Iron & Steel Company, Limited, will be revived. The chairman of the board will be the managing director of the United Steel Companies, Limited, viz., Capt. R. S. Hilton, and the following leading officials of Workington have been appointed to the board :—Mr. Langton Highton, Mr. A. Millar, Mr. W. L. James, Mr. A. E. Leek, and Mr. R. McCowan. Mr. Langton Highton has been made general manager, iron and steel, and Mr. A. Millar general manager of the collieries and ore mines.

In order to identify the company with West Cumberland, several gentlemen interested in that district have been invited to join the board. This subsidiary company will be part of the United Steel Companies combine, and as such will be subject to the general control of the parent company, which will retain the assets and be responsible for all liabilities as in the past.

International Ferro-Silicon Syndicate

The International Ferro-Silicon Syndicate, which was provisionally prolonged until the end of December, has now been extended until the beginning of May. A longer period has been impossible owing to notices which have been given by certain Scandinavian producers, who do not approve of the price policy of the Syndicate. A further meeting of the Syndicate to deal with the secession of these Scandinavian producers will be held at the end of this month. Prices are being maintained in spite of undercutting by certain independents.

TRADE MARK
SIROCCO
FANS
for every Problem involving the movement of air or Hot Gases
Established nearly sixty years
DAVIDSON & CO. LIMITED
SIROCCO ENGINEERING WORKS. BELFAST. N. IRELAND
F "SIROCCO" REVERSIBLE PROPELLER FANS
A "SIROCCO" CASED FANS (with various classes of Fan Wheels)
N "AEROTO" (Trade Mark) PATENT SCREW FANS
S "SIROCCO" WATER COOLED BEARINGS (used with Fans handling Hot Gases)
LONDON · MANCHESTER · NEWCASTLE · BIRMINGHAM · CARDIFF · GLASGOW · DUBLIN

Have YOU tried . . .

"TICYL"

The NEW

ALL-MINE LOW CARBON, LOW PHOSPHORUS

CYLINDER PIG IRON

G. & R. THOMAS LTD.

HATHERTON BLAST FURNACES,

BLOXWICH, STAFFORDSHIRE.

Telegrams: THOMAS BLOXWICH. Phone: No. 6341.

The Week's News in Brief

Trade Talk

THE FURNESS SHIPBUILDING COMPANY, LIMITED, Haverton Hill-on-Tees, have received an order from the Eagle Oil Company for a 12,000-ton tanker.

THE LANARKSHIRE STEELWORKS WELFARE ASSOCIATION held their annual concert and dance in the Town Hall, Motherwell, Bailie Charles Donnelly presiding.

THE ADMIRALTY have decided to entrust the construction of two escort vessels of the 1937 programme to Yarrow & Company, Limited, Scotstoun, Glasgow. The vessels will be of 1,200 tons displacement.

A LARGE CASTING left the Brightside Foundry & Engineering Company's works at Sheffield last week on the way to Glasgow to be fitted into a ship on the Clyde. The casting weighs 68 tons.

TWENTY-FOUR AUTO-TRUCKS, supplied by R. A. Lister & Company, Limited, of Dursley, are to be in use at the Birmingham Section of the British Industries Fair in February for the installation of exhibits.

BABCOCK & WILCOX, LIMITED, of Renfrew, have obtained an order amounting to £36,000 for the erection and supply of material for integral economiser units for the Mildura power station, Australia.

THE DIRECTORS of International Diatomite Company, Limited, have declared an interim dividend in respect of the year ending June 30, 1938, of 4 per cent. (actual) less tax, payable on January 31, to shareholders registered on January 20. This compares with an interim payment last year of 2 per cent.

E. HIND (SOUTH BANK), LIMITED, iron, steel and metal merchants, announce that a new aluminium rotary furnace, which is claimed to be the biggest in Europe, will be started in the course of the next few days. The furnace, which will have a capacity of 5 tons per day, has been built to the design of German engineers. The firm has also taken over the premises of the former Eston Sheet & Galvanising Company, Limited, and are preparing plans for their development.

THE DUKE OF KENT will be principal guest at the Birmingham Chamber of Commerce annual banquet on February 28, at which the Earl of Dudley, President of the Birmingham Chamber of Commerce and of the British Cast Iron Research Association, will preside. The guests include the French Ambassador and the President of the Board of Trade. On the morning after the banquet the Duke will visit the Engineering and Hardware Section of the British Industries Fair at Castle Bromwich.

Company Meeting

The annual meeting of Cannon Iron Foundries, Limited, was held at Deepfields, Bilston, on December 31. MR. R. TALBOT CLAYTON (managing director), who presided in the absence of the chairman, Mr. G. A. Leitch, said that net additions to land and buildings and to plant, machinery, etc., had cost £12,474 during the year. This expenditure was considered necessary to enable the works to meet the demand for larger output, and to speed up deliveries. Unfortunately, they had been prevented from obtaining full productive benefit from these improvements until quite recently, due to the steel shortage, which delayed by several months the completion of orders for equipment which they placed more than 12 months ago. The outlay had proved fully justified during recent months by a substantial increase in output from the departments concerned. The profit on trading, £62,148, was £14,800 less than for 1936, notwithstanding the fact that the turnover again exceeded that of the previous year and constituted a record for the company. During the year the prices of some of their principal raw materials, notably pig-iron and fuel, had risen to very high levels, and increases in wage rates had cost the company some thousands of pounds. They had, of course, been obliged to increase selling prices to some extent, but it had been their policy to keep such increases as low as they reasonably could. The sales for the first quarter of the current year compared very favourably with those of the same period last year, while orders on the books were of substantial amount and would ensure a satisfactory turnover during the first half of 1938.

Personal

MR. S. E. DAWSON has changed his private address to 21, Middleton Crescent, Beeston, Notts.

MR. FRED C. STEWART has joined the board of Brown Bros. & Company, Limited, engineers and ironfounders, of Edinburgh.

SIR LOUIS BEALE, K.C.M.G., C.B.E., has been appointed Commissioner-General for the United Kingdom section of the New York World's Fair, 1939.

MR. J. F. DAVIES, chairman and a managing director of John Wright & Company, Limited, Birmingham, has been appointed deputy-chairman of Radiation, Limited.

MR. JOHN HOWE HALL, the well-known American consultant on steel-foundry practice, has changed his address to 6802, Lincoln Drive, Germantown, Philadelphia, Pa., U.S.A.

Wills

REICHWALD, V. B., iron, steel and machinery merchant	£12,308
MILLS, M. W., of Heywood, Lancs, a member of James Mills & Company (Engineers), Limited	£26,367

Obituary

MR. EBENEZER TIMMINS, a director of E. Timmins & Sons, Limited, Runcorn, artesian well borers, engineers, and ironfounders, has died at the age of 63 years.

MR. CHARLES H. KEEN, assistant managing director of Guest Keen Baldwins Iron & Steel Company, Limited, and a director of Guest, Keen & Nettlefolds, Limited, has died at the age of 36.

WE REGRET to announce the death of Mr. Charles Edward Thomas, in his 80th year. Mr. Thomas was connected with the London office of Metters, Limited, the Australian foundry concern, for 26 years, and took an active part in it up to the day of his death.

WE REGRET to announce the death, on January 8, of Mr. Arthur J. Ward, J.P., assistant managing director of Thos. W. Ward, Limited, Sheffield. He had been connected with the firm for 56 years. Joining it shortly after he entered business, he was for a time connected with the ivory-horn handle and stag hook and silent machine departments, which still form small departments of the firm. When still in his teens he travelled for orders in connection with these both in London and on the Continent. Later he was made a partner in the firm, and when this was formed into a limited company some years later he became assistant managing director. Mr. Ward's activities were wider than the industrial life of Sheffield, for he gave unstinted services to social, philanthropic and religious causes. For five years he was on the Sheffield City Council.

Contributions to Charity

The following firms engaged in the foundry, engineering and allied industries have made contributions to charities during the past year:—Albion Motors, Limited, £880; Argus Foundry, Limited, £105; Babcock & Wilcox, Limited (six months), £387; Blair's, Limited, £202; Blantyre Engineering Company, Limited, £64; Bonnybridge Silica & Fireclay Company, Limited, £185; British Ropes, Limited, £120; Colvilles, Limited, £7,269; A. F. Craig & Company, Limited, £203; Cruickshank & Company, Limited, £288; Dennystown Forge Company, £70; Drysdale & Company, Limited, £414; Etna Iron & Steel Company, Limited, £107; Glasgow Iron & Steel Company, Limited, £544; Glenfield & Kennedy, Limited, £737; James Howden & Company, Limited, £572; Lobnitz & Company, Limited, £422; Walter MacFarlane & Company, Limited, £503; William Martin, Sons & Company, £101; North British Locomotive Company, Limited, £796; Rivet, Bolt & Nut Company, Limited, £601; Scott's Shipbuilding & Engineering Company, Limited, £1,622; Shaw Glasgow, Limited, £272; William Simons & Company, Limited, £480; Springfield Steel Company, Limited, £106; Alexander Stephen & Sons, Limited, £1,416; Stewarts and Lloyds, Limited, £4,272; D. & J. Tullis, Limited, £268; and John Williams & Company (Wishaw), 1922, Limited, £134.

Foundry Trade Journal

PUBLISHED WEEKLY

Subscription Terms: 17s. 6d. per annum.
Foreign and Colonial: 20s. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

Contracts Open

Bala, January 19.—Providing and laying 688 yds. of 3-in. spun-iron pipes, for the Urban District Council. F. J. Rodwell & Son, engineers, Prudential Buildings, 20, Park Row, Leeds, 1. (Fee £2 2s., returnable.)

Blackpool, January 24.—Iron, steel, tubes, fittings, etc., for the Town Council. The Borough Treasurer (Room 1), Central Tendering Branch, Corporation Street, Blackpool.

Cairo, February 2.—Supply and erection of one sewage pumping unit and auxiliary machinery, for the Director-General, Main Drainage Department, No. 4, Sharia El Antikkhana, Cairo. The Inspecting Engineer to the Egyptian Government, 41, Tothill Street, London, S.W.1.

Johannesburg, February 19.—2-ton floor-controlled electrically-operated crane, for the City Council. The Department of Overseas Trade. (Reference T.Y. 31867/37.)

Southampton, January 18.—Motor-driven boiler feed pump capable of delivering normally not less than 270,000 lbs. of feed water per hr., for the Electricity Department. Mr. W. G. Turner, borough electrical engineer, Civic Centre, Southampton. (Fee £1 1s., returnable.)

Stafford, January 14.—Breaking and screening plant, for the County Council. Mr. R. S. Murt, county surveyor, County Buildings, Stafford.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Cliff Vale Engineering Works, Limited, Cliff Vale, Stoke-on-Trent.—Capital, £2,000. Directors: G. B. Greatbatch and T. L. Wright.

Edward Holtom, Limited, 1/2, Great Winchester Street, London, E.C.—Capital, £1,000 in £1 shares. Mechanical and general engineers, etc.

Overstall & Sons, Limited, Engineering Works, Bacup Road, Cloughfold, Rawtenstall.—Capital £5,000. Elevator and conveyor engineers. Directors: F. P. Overstall and G. Overstall.

New Vittoria Engineering Company, Limited, 252, Price Street, Birkenhead.—Capital, £2,000. Engineers, ship repairers and boiler makers. Directors: H. Owen, T. Pierpoint, G. E. Tilling, R. C. Tanner, T. R. Gaunt and J. Hall.

Forthcoming Events

JANUARY 18.

Institute of Metals (Birmingham Section):—"Creep of Metals at High Temperatures," Paper by R. W. Bailey, at James Watt Memorial Institute, Birmingham, at 7 p.m.

Institute of British Foundrymen

JANUARY 17.

Lincolnshire Section:—"The Foundry Metallurgist," Paper by G. L. Harbach, at Lincoln Technical College, at 6.45 p.m.

JANUARY 20.

East Anglian Section:—"Developments in Core Production Methods," Paper by G. E. France, at Central Library, Ipswich, at 7.30 p.m.

JANUARY 22.

Burnley Section:—Social, at Greenwood's Café, Todmorden Road, Burnley.

East Midlands Branch:—Paper by A. E. Pearce and P. A. Russell, at College of Technology, Leicester, at 6 p.m.

The Institute of Vitreous Enamellers

JANUARY 20.

Northern Section:—"Application of the Radiant Tubular-Element System," Paper by A. A. Straub, at Queen's Hotel, Manchester, at 7.30 p.m.

TOR ROCK SAND
for the
FOUNDRY

Higher casting temperatures in iron foundries—particularly in those where special alloys are melted—have resulted in a demand for a moulding sand to withstand severe conditions and produce sound castings of good finish. Tor Rock Sand has proved to be specially suitable for these requirements. It is coarse in grain and highly permeable and being somewhat irregularly graded, tends to give a strong and compact mould surface.

Please write for full particulars and sample to the nearest sales office:

GENERAL REFRACTORIES LIMITED
GENEFAX HOUSE, SHEFFIELD.

Telephone: 31113 (6 lines).
Telegrams: "Genefax, Sheffield."

LONDON OFFICE: Russell House, Adelphi, W.C.2. Telephone: Temple Bar 3511. Telegrams: "Genefax, Rand-London." (Mr. A. C. Turner).

SCOTTISH OFFICE: 48, West Regent Street, Glasgow, C.2. Telephone: Douglas 6108 (3 lines). Telegrams: "Genefax, Glasgow." (Mr. C. A. G. Thomson).

SWANSEA OFFICE: Metropole Chambers, Wind Street. Telephone: 3690. Telegrams: "Genefax, Swansea." (Mr. D. F. Hood-Williams).

MANCHESTER OFFICE: 9, Albert Square. Telephone: Blackfriars 6130. Telegrams: "Genefax, Manchester." (Mr. S. G. Throssell).

MIDDLESBROUGH OFFICE: Halifax Bldgs, Exchange Place. Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr. J. A. Williams).

CARDIFF OFFICE: 17, Windsor Place. Telephone: 5796. Telegrams: "Genefax, Cardiff." (Mr. F. E. Rutter).

Raw Material Markets

In most areas pig-iron makers have begun the new year with deliveries still to be made under orders placed last year, but there are supplies available for new business. Cleveland pig-iron is still in short supply, the furnaces concentrating on steel-making irons, but the needs of the ironfounders are being met from the Midlands and elsewhere.

Pig-Iron

MIDDLESBROUGH.—The demand for steel-making iron is so heavy that the output of Cleveland foundry iron cannot easily be increased. It is unlikely that the position will be much altered at the end of the half-year, which is as far as producers will book at current prices, as delivery arrears from last year are still substantial, and the necessary leeway will not be made up unless production is expanded. Makers have exercised caution in booking new orders, but estimated production is well accounted for by contracts. Consumers have also booked supplies with makers in the Midlands, and so are less inconvenienced than they otherwise would have been.

The hematite market is now more satisfactory, both on home and export account. Heavy business has gone through, but supplies are better and consequently shipments have been made on a larger scale, although there are still some outstanding requirements to be met. East Coast mixed numbers are quoted at 132s. 6d. per ton on the North-East Coast, 138s. in Sheffield, and 143s. 6d. in the Midlands, less 5s. per ton rebate.

LANCASHIRE.—Activity at the light-castings plants is still on the quiet side, but it is anticipated that an expansion of operations will take place before very long. Other consumers of pig-iron, with the exception of the textile machinists, are well employed and have contracted for heavy supplies for delivery over the first few months of the year. Thus, makers are assured of strong conditions as far ahead as current prices will allow business to be transacted. For delivery in the Lancashire price zone over the first half of the year, Derbyshire and Lancashire brands of No. 3 pig-iron are quoted on the basis of 114s., with Northamptonshire No. 3 at 112s. 6d. and Derbyshire forge iron 111s. to 113s., according to the class of consumer. Scottish No. 3 is at around 141s. per ton, but it is difficult to obtain supplies. The hematite market is firm. West Coast mixed numbers are quoted at 141s., with East Coast material at 140s. 6d.

MIDLANDS.—Although the demand for pig-iron is fairly heavy, little difficulty is experienced in meeting inquiries, as the supply position is quite satisfactory, and at most of the producing plants there is a small surplus available after contract orders have been met. Business with consumers in other districts continues to be on a good scale. For delivery to Birmingham and Black Country stations and subject to a rebate of 5s. per ton, Derbyshire, Lincolnshire and North Staffordshire No. 3 foundry iron is quoted at 111s., with Northamptonshire No. 3 at 108s. 6d. If required for puddling purposes, forge pig-iron is quoted at 3s. per ton below No. 3 foundry iron, while foundries may obtain this iron at 1s. less than No. 3 foundry iron. Supplies are now adequate. Low-phosphorus iron is quoted at from £6 7s. 6d. to £7 10s., according to quality and position of supplies. Refined iron is at a minimum of £8 5s. per ton. Generally, consumers of these grades are well covered for the time being. Ordinary grades of hematite are fairly easy to obtain, but there is some difficulty in procuring supplies of special descriptions. Some consumers have booked tonnages up to the end of the year, but, on the whole, contracts have not been made for deliveries after the end of June.

SCOTLAND.—A general restart after the New Year holidays was made at the beginning of this week. As is the case in other districts, the light-castings founders are comparatively quiet, but in other sections good order-books are held. Scottish No. 3 foundry iron is quoted at 118s. 6d. at the furnaces, with No. 1 at 120s. 6d. Exports continue to be very restricted and only one ton was despatched abroad last week. No. 3 Cleveland iron is nominal at 109s. f.o.t. Falkirk and 112s. f.o.t. Glasgow, less 5s. rebate. Indian iron is being received in this area in fair tonnages and this is helping to relieve the shortage of steel-making irons. For delivery to local steelworks, hematite mixed numbers are quoted at 133s., with Scottish basic at 107s. 6d., and English and Indian basic at 100s. per ton.

Coke

It now appears to be somewhat easier to obtain supplies on the foundry-coke market, but pressure for contract tonnages is very heavy and the surplus is not sufficient to enable consumers to take up much in the way of supplementary supplies. For delivery in Birmingham and district, best Durham foundry coke is quoted at 55s. 9d., with Welsh coke at from 55s. to 65s. per ton.

Steel

Great industrial activity prevails in the steel industry, and the busy conditions which ruled immediately before the holidays have been well maintained since operations were resumed. New business, however, is quiet in most departments, since consumers appear to have covered the bulk of their requirements for the next few months, and the producing works are well sold for the first half of this year. In the semi-finished steel section, conditions have greatly improved, compared with even a month or two ago, and there are prospects that the position will continue to grow more satisfactory. The consuming works, however, are still receiving somewhat limited supplies, but fewer complaints are now heard regarding the difficulty of maintaining a full rate of operations owing to the scarcity of raw material. Business in the finished steel market has been on a rather restricted scale, as the producers are only able to accept orders for far forward delivery owing to the congested state of their order-books. Consumers seem to have largely covered their future requirements, and neither they nor the makers seem anxious to commit themselves to distant delivery dates.

Scrap

The new year has not brought any relaxation in the demand for iron and steel scrap and available supplies are quickly taken up. Fixed prices for steelworks' scrap came into operation at the beginning of the year and these are being strictly adhered to in all transactions. Business is particularly restricted in the Cleveland district, as there is almost nothing to be had outside contracts.

Metals

Copper.—A feature of this market during the week has been four small increases in the United States domestic quotation. The American Smelting & Refining Company has now raised its price to 11 cents per lb. The weekly market report issued by Brandeis, Goldschmidt & Company, Limited, states that the market has been firm and the price has risen in an orderly way. If producers only will leave well alone now, we should be able to look forward to steady markets for a while, followed by slowly-advancing prices later in the year.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £40 16s. 3d. to £40 17s. 6d.; Friday, £41 12s. 6d. to £41 13s. 9d.; Monday, £42 12s. 6d. to £42 13s. 9d.; Tuesday, £44 3s. 9d. to £44 5s.; Wednesday, £44 2s. 6d. to £44 3s. 9d.

Three Months.—Thursday, £41 to £41 2s. 6d.; Friday, £41 16s. 3d. to £41 17s. 6d.; Monday, £42 16s. 3d. to £42 17s. 6d.; Tuesday, £44 7s. 6d. to £44 8s. 9d.; Wednesday, £44 6s. 3d. to £44 7s. 6d.

Tin.—The tone of this market has improved recently, and the outlook is now more promising. In an interview, Mr. Ruimschotel, managing director of the Banka Tin Selling Agency, of The Hague, said that a reduction of the tin quota would not lessen the activity of Banka and Billiton to any extent.

Official quotations were as follow :—

Cash.—Thursday, £184 to £184 5s.; Friday, £186 5s. to £186 10s.; Monday, £185 15s. to £186; Tuesday, £188 10s. to £188 15s.; Wednesday, £191 to £191 5s.

Three Months.—Thursday, £183 15s. to £184; Friday, £186 to £186 5s.; Monday, £185 10s. to £185 15s.; Tuesday, £188 10s. to £188 15s.; Wednesday, £190 12s. 6d. to £190 17s. 6d.

Spelter.—This metal has remained on the dull side, and business has been very quiet.

Daily market prices :—

Ordinary. — Thursday, £14 15s.; Friday, £15 1s. 3d.; Monday, £15 6s. 3d.; Tuesday, £15 15s.; Wednesday, £15 17s. 6d.

Lead.—A firmer tone has been in evidence in this market during the past week, and the immediate outlook is quite satisfactory.

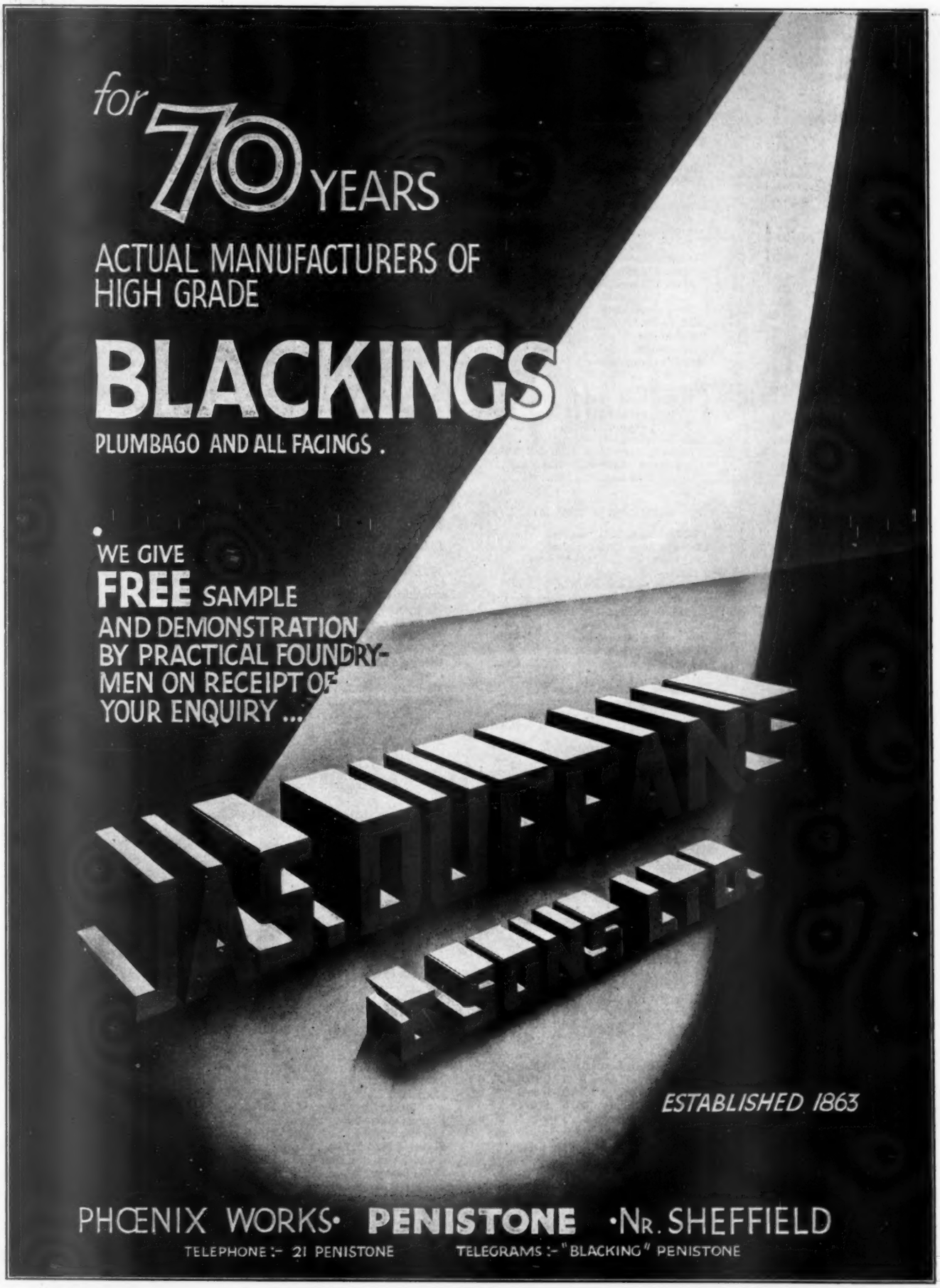
Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £15 18s. 9d.; Friday, £16 3s. 9d.; Monday, £16 10s.; Tuesday, £16 18s. 9d.; Wednesday, £17 11s. 3d.

Scrap.—Little expansion has taken place in the demand in this section of the market, and a dull tone persists. Prices show little change.

PREPARED VITREOUS ENAMELS
For Sheet and Cast Iron, Baths, Stoves, etc., Copper, Jewellery, and Electrical Resistances
All kinds of Chemicals for Vitrification
Colouring Oxides for Enamelled Iron
WENGERS LTD
CERAMIC COLOURS & CHEMICALS
ETRURIA
STOKE-ON-TRENT
England
Oxides of Cobalt, Chrome, Copper, Iron, Nickel, Manganese, Uranium
Pyramid Cones for Testing Temperatures
Manufacturers of British Snow White Oxide of Tin

REDUCE SAND COSTS AND INCREASE EFFICIENCY using
BENTONITE
(THE SUPER BOND)
FOR FACING SAND.
STOCKS HELD IN
MANCHESTER, LONDON, HULL, GLASGOW.
Demonstrations gladly given by appointment.
DISTRICT CHEMICAL Co LTD
52/4, LEADENHALL STREET, LONDON, E.C.3.
Phone: ROYAL 5 34. Grams: NATRON, LONDON.


for 70 YEARS
ACTUAL MANUFACTURERS OF HIGH GRADE
BLACKINGS
PLUMBAGO AND ALL FACINGS.
WE GIVE
FREE SAMPLE
AND DEMONSTRATION
BY PRACTICAL FOUNDRY-
MEN ON RECEIPT OF
YOUR ENQUIRY...
ESTABLISHED 1863
PHŒNIX WORKS· PENISTONE ·NR. SHEFFIELD
TELEPHONE :- 21 PENISTONE
TELEGRAMS :- "BLACKING" PENISTONE

RAW MATERIALS—PRICE LIST

(Wednesday, January 12, 1938)

COPPER

	£	s.	d.
Standard cash	44	2	6
Three months	44	6	3
Electrolytic	48	7	6
Tough	47	5	0
Best selected	47	15	0
Sheets	76	0	0
India	59	15	0
Wire bars	49	0	0
Ingot bars	49	0	0
H.C. Wire rods	52	10	0
Off. av. cash, Dec.	39	19	8¼
Do., 3 mths., Dec.	40	4	3 9/11
Do., Sttlmnt., Dec.	39	19	6 8/11
Do., Electro, Dec.	44	10	4 7/11
Do., B.S., Dec.	44	8	7⅛
Do., Wire bars, Dec.	45	2	11 5/11
Solid drawn tubes			12¼d.
Brazed tubes			12½d.
Wire			8¼d.

BRASS

Solid drawn tubes	11½d.
Brazed tubes	13½d.
Rods, drawn	9⅛d.
Rods, extd. or rlld.	6d.
Sheets to 10 w.g.	8⅝d.
Wire	8⅜d.
Rolled metal	8½d.
Yellow metal rods	6d.

TIN

	£	s.	d.
Standard cash	191	0	0
Three months	190	12	6
English	191	0	0
Bars	193	0	0
Straits	194	10	0
Eastern	191	5	0
Banca (nom.)		—	
Off. av. cash, Dec.	190	12	1 5/12
Do., 3 mths., Dec.	189	18	8 7/12
Do., Sttlmt., Dec.	190	11	9 9/11

SPELTER

	£	s.	d.
Ordinary	15	17	6
Remelted	12	10	0
Hard	12	0	0
Electro, 99.9	19	15	0
English	16	17	6
India	15	10	0
Zinc dust	23	15	0
Zinc ashes	6	0	0
Off. aver., Dec.	15	7	0 3/4
Aver., spot, Dec.	15	5	5 13/44

LEAD

	£	s.	d.
Soft foreign, ppt.	17	11	3
Empire (nom.)	17	10	0
English	19	10	0
Off. aver., Dec.	15	15	5 35/44
Aver., spot, Dec.	15	18	11 79/88

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	29	0	0 to 29	10	0
Do., V.M. ex-whse.	29	0	0 to 29	10	0
Rods			23	0	0

ANTIMONY

English	81	0	0 to 82	0	0
Chinese, ex-whse.			66	0	0
Crude, c.i.f.			39	0	0

QUICKSILVER

Quicksilver			12	17	3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—					
25%			14	10	0
45/50%			12	0	0
75%			17	0	0
Ferro-vanadium—					
35/50%			14/- lb. Va.		
Ferro-molybdenum—					
70/75% carbon-free			4/9 lb. Mo.		
Ferro-titanium—					
20/25% carbon-free			9d. lb.		
Ferro-phosphorus, 20/25%			£21 to £22		
Ferro-tungsten—					
80/85%			8/6 lb.		
Tungsten metal powder—					
98/99%			8/7½ lb.		
Ferro-chrome—					
2/4% car.			34	15	0
4/6% car.			24	5	0
6/8% car.			24	0	0
8/10% car.			24	0	0
Ferro-chrome—					
Max. 2% car.			36	0	0
Max. 1% car.			38	5	0
Max. 0.5% car.			41	0	0
70% carbon-free			10d. lb.		
Nickel—99.5/100%			£180 to £185		
"F" nickel shot			£165	0	0
Ferro-cobalt, 98/99%			8/6 to 8/9 lb.		
Metallic chromium—					
96/98%			2/5 lb.		
Ferro-manganese—					
76/80% loose	£18	15	0 to 19	5	0
76/80% packed	£19	15	0 to 20	5	0
76/80% export			£22	0	0
Metallic manganese—					
94/96% carbon-free			1/3 lb.		

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 10d.
Finished bars, 18% tungsten	5s. 0d.

Per lb. d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to ⅛ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales (West)—						
Heavy steel, best	3	8	9 to 3	11	3	
Mixed iron and steel	3	6	9 to 3	9	3	
Heavy cast iron	3	8	9 to 3	11	3	
Good machinery			3	17	6	
Cleveland—						
Heavy steel, best	3	7	0 to 3	9	6	
Steel turnings	2	13	0 to 2	15	6	
Heavy cast iron			4	5	0	
Heavy machinery			4	10	0	
Midlands—						
Short heavy steel			4	0	0	
Light cast-iron scrap			3	2	6	
Heavy wrought iron	4	0	0 to 4	5	0	
Steel turnings	2	6	3 to 2	8	9	
Scotland—						
Heavy steel, best	3	5	0 to 3	7	6	
Ordinary cast iron	4	5	0 to 4	7	6	
Cast-iron borings	2	0	6 to 2	3	0	
Wrot-iron piling	4	5	0 to 4	7	6	
Heavy machinery	4	0	0 to 4	2	6	

London—Merchants' buying prices, delivered yard.

Copper (clean)	35	0	0
Brass	24	10	0
Lead (less usual draft)	15	0	0
Tea lead	11	10	0
Zinc	8	10	0
New aluminium cuttings	71	0	0
Braziery copper	31	0	0
Gunmetal	35	0	0
Hollow pewter	135	0	0
Shaped black pewter	97	0	0

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
,, No. 3	109/-
,, No. 4	108/-
Forge No. 4	108/-
Hematite No. 1	133/-
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	133/-
,, d/d Birm.	144/6
Malleable iron d/d Birm.	165/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/-
,, No. 3 fdry.	111/-
Northants forge	107/6
,, fdry. No. 3	108/6
,, fdry. No. 1	111/6
Derbyshire forge	110/-
,, fdry. No. 3	111/-
,, fdry. No. 1	114/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
,, No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	112/-
,, ,, Falkirk	109/-
Scottish hem. M/Nos. d/d	133/-
Sheffield (d/d district)—	
Derby forge	107/6
,, fdry. No. 3	108/6
Lincs forge	107/6
,, fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/-
Glengarnock, No. 3	141/-
Clyde, No. 3	141/-
Monkland, No. 3	141/-
Summerlee, No. 3	141/-
Eglinton, No. 3	141/-
Gartsherrie, No. 3	141/-
Shotts, No. 3	141/-

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	13	5	0 to 13	15	0	
Nut and bolt iron	11	12	6 to 12	2	6	
Hoops			14	2	6	
Marked bars (Staffs) f.o.t.			15	15	0	
Gas strip			14	2	6	
Bolts and nuts, ¾ in. × 4 in.			17	10	0 and up	
Steel—						
Plates, ship, etc.	11	8	0 to 11	10	6	
Boiler plts.	11	18	0 to 12	0	6	
Chequer plts.			13	0	6	
Angles			11	0	6	
Tees			12	0	6	
Joists			11	0	6	
Rounds and squares, 3 in. to 5½ in.			12	0	6	
Rounds under 3 in. to ⅜ in. (untested)			11	9	0	
Flats—8 in. wide and over			11	5	6	
,, under 8 in. and over 5 in.			11	10	6	
Rails, heavy			10	2	6	
Fishplates			14	2	6	
Hoops (Staffs)			12	4	0	
Black sheets, 24g. (4-t. lots)			15	15	0	
Galv. cor. shts. (,,)			18	10	0	
Galv. flat shts. (,,)			19	0	0	
Galv. fencing wire, 8g. plain			20	5	0	
Billets, soft, 100-ton lots			7	17	6	
Sheet bars			7	15	0	
Tin bars			7	15	0	

PHOSPHOR BRONZE

	Per lb. basis
Strip	11d.
Sheet to 10 w.g.	11½d.
Wire	12¾d.
Rods	13½d.
Tubes	18½d.
Castings	15½d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2¾ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round— to 10g.	1/5½ to 2/0½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	42/6
,, furnace	37/6
Durham foundry	38/6
,, furnace	37/6
Scottish foundry	42/6
,, furnace	40/-

TINPLATES

f.o.b. British Channel ports.

I.C. cokes	20×14 per box		22/6 to 23/-
,,	28×20 ,,		45/- to 46/-
,,	20×10 ,,		34/9 to 35/3
,,	18¾×14 ,,		24/9 to 25/3
C.W.	20×14 ,,		18/9 to 19/9
,,	28×20 ,,		37/6 to 39/6
,,	20×10 ,,		30/3 to 31/-
,,	18¾×14 ,,		21/3 to 21/9

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£12	0	0 to £13	0	0
Bars-hammered, basis	£20	0	0 to £22	0	0
Bars and nail-rods, rolled, basis	£19	0	0 to £20	0	0
Blooms	£18	0	0 to £19	0	0
Keg steel	£30	0	0 to £35	0	0
Faggot steel	£20	0	0 to £25	0	0
Bars and rods dead soft st'l	£19	0	0 to £20	0	0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
Jan.	6 ..	40 16 3 dec.	2/6
,,	7 ..	41 12 6 inc.	16/3
,,	10 ..	42 12 6 ,,	20/–
,,	11 ..	44 3 9 ,,	31/3
,,	12 ..	44 2 6 dec.	1/3

Electrolytic Copper

		£ s. d.	
Jan.	6 ..	45 0 0 dec.	5/–
,,	7 ..	46 0 0 inc.	20/–
,,	10 ..	46 15 0 ,,	15/–
,,	11 ..	48 0 0 ,,	25/–
,,	12 ..	48 7 6 ,,	7/6

Standard Tin (cash)

		£ s. d.	
Jan.	6 ..	184 0 0 dec.	50/–
,,	7 ..	186 5 0 inc.	45/–
,,	10 ..	185 15 0 dec.	10/–
,,	11 ..	188 10 0 inc.	55/–
,,	12 ..	191 0 0 ,,	50/–

Tin (English ingots)

		£ s. d.	
Jan.	6 ..	184 0 0 dec.	50/–
,,	7 ..	186 5 0 inc.	45/–
,,	10 ..	185 15 0 dec.	10/–
,,	11 ..	188 10 0 inc.	55/–
,,	12 ..	191 0 0 ,,	50/–

Spelter (ordinary)

		£ s. d.	
Jan.	6 ..	14 15 0 dec.	3/9
,,	7 ..	15 1 3 inc.	6/3
,,	10 ..	15 6 3 ,,	5/–
,,	11 ..	15 15 0 ,,	8/9
,,	12 ..	15 17 6 ,,	2/6

Spelter (Electro, 99.9 per cent.)

		£ s. d.	
Jan.	6 ..	18 11 3 dec.	2/6
,,	7 ..	18 17 6 inc.	6/3
,,	10 ..	19 2 6 ,,	5/–
,,	11 ..	19 12 6 ,,	10/–
,,	12 ..	19 15 0 ,,	2/6

Lead (soft foreign, prompt)

		£ s. d.	
Jan.	6 ..	15 18 9 inc.	3/9
,,	7 ..	16 3 9 ,,	5/–
,,	10 ..	16 10 0 ,,	6/3
,,	11 ..	16 18 9 ,,	8/9
,,	12 ..	17 11 3 ,,	12/6

Lead (English)

		£ s. d.	
Jan.	6 ..	18 0 0 inc.	5/–
,,	7 ..	18 5 0 ,,	5/–
,,	10 ..	18 10 0 ,,	5/–
,,	11 ..	19 0 0 ,,	10/–
,,	12 ..	19 10 0 ,,	10/–

AVERAGE MONTHLY PRICES OF STEEL RAILS

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1922	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 0 0	8 15 0	8 15 0	8 15 0	8 15 0	9 4 2
1923	8 17 6	9 2 0	10 5 0	10 10 0	10 10 0	10 10 0	9 15 0	9 0 0	8 15 0	8 15 0	8 19 0	9 5 0	9 9 10
1924	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 2 6	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 2 3½
1925	9 0 0	9 0 0	9 0 0	9 0 0	8 15 0	8 10 7½	8 10 0	8 10 0	8 10 0	8 4 0	8 0 0	8 0 0	8 11 7½
1926	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 10 0	8 3 11½
1927	8 10 0	8 10 0	8 10 0	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 3 0	8 5 0	8 5 0	8 4 10
1928	8 5 0	8 5 0	8 5 0	8 5 9	8 6 3	8 6 3	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 7 9½
1929	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0
1930	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0
1931	8 9 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 8
1932	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1933	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1934	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1935	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1936	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1937	8 7 6	8 7 6	8 7 6	8 7 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	9 10 6

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE MIXED NUMBERS AT MIDDLESBROUGH*

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1921	240 0	220 0	180 0	180 0	180 0	160 0	160 0	160 0	137 0	127 6	117 6	104 6	162 2
1922	97 6	91 7½	100 0	98 6	97 1½	94 7	93 6	90 9	89 7	91 10½	93 0	93 2	94 5½
1923	94 6	104 9	122 0	126 10½	122 0	115 3	107 0	98 8½	98 10½	99 1½	100 6½	102 3	107 10½
1924	102 4½	101 3	99 7½	99 0	98 9½	97 4½	95 3½	93 1½	90 7½	88 0	88 4½	88 6	95 2½
1925	87 5	85 9	84 7½	82 6	80 10½	79 3	77 1½	75 7½	75 0	74 3½	74 9	76 0	79 5½
1926	77 3	77 9	77 3½	76 3	77 4½	78 0	79 8½	81 9	83 4½	87 7½	92 6	90 5½	81 7½
1927	90	90 0	86 3½	83 1½	80 6	78 0	76 6	75 4½	75 0	72 9	71 9	71 1½	79 2½
1928	69 7½	69 7½	69 9	70 0	70 0	69 3	68 7½	69 2	70 0	70 0	70 3	71 0	69 9½
1929	71 6	72 0	73 6	74 0	74 0	74 1½	74 9	75 6	76 1½	76 8½	78 1½	79 0	74 11½
1930	78 2½	78 0	76 9	75 0	74 0	72 7½	71 0	71 0	71 0	71 0	70 10½	70 4½	73 3½
1931	70 0	69 0	68 0	66 8½	65 1½	63 4½	62 9	61 1½	65 0	65 0	65 0	65 0	65 6
1932	64 10	64 3	63 6	63 6	63 6	62 7½	62 0	60 6	60 0	59 3	59 0	59 0	61 10
1933	59 0	59 0	59 0	59 0	59 0	59 0	59 0	59 0	59 3	60 7½	62 6	62 6	59 8½
1934	62 6	65 0	67 6	67 6	67 6	67 6	67 6	67 6	68 0	68 6	68 6	68 6	67 2
1935	68 6	68 6	68 6	68 6	68 6	68 6	69 7½	70 6	70 6	70 6	70 6	70 6	69 5½
1936	70 6	75 3	76 6	76 6	77 4	80 0	85 0	85 0	85 0	85 0	85 0	85 0	80 6
1937	97 6	97 6	97 6	97 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	114 2

* Since March, 1934, delivered works; previously f.o.t. furnaces. NOTE.—Prices of hematite have since July 1, 1936, been subject to a rebate of 5s. under certain conditions.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

FOR EVERY TYPE OF CASTING

NON-FERROUS METALS

REFRACTORIES — COKE — SAND

FERRO-SILICON—FERRO-CHROME

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

PROGRESSIVE Foundry Manager, age 40, at present engaged in foundry taking in all types of general engineering castings, mechanised plant, iron and non-ferrous, pattern-shop, etc. Fully capable of taking entire charge and guarantee results. Go anywhere.—Box 740, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

CORE SHOP Superintendent required for steel foundry in the Midlands. Must possess wide experience of miscellaneous cores and up-to-date methods of production on repetition lines. An attractive post for the right man. Apply giving age, experience, and wage expected to: Box 736, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN (Grey Iron) wanted; able to control production and quality from 100 bench and machine moulders on plate, oddside and loose pattern work. Big salary to really smart man. Apply stating age, experience, and terms to: Box 730, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

REPRESENTATIVE REQUIRED for the sale of Refractories in the Midlands area. Ex-foundry manager might suit. State in writing full details and salary required to: Box 746, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, for new foundry in Midlands, four good Moulders, capable of producing castings of any weight for high-class machine work. Full district rate paid to first-class men who are looking for an opportunity.—JOSHUA BIGWOOD & SON, LTD., Wolverhampton.

AGENCIES

AGENT for sale of high class grey-iron castings in Yorkshire wanted by Staffordshire Ironfoundry. Good prospects. State age and proposed terms and details of experience to: Box 724, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PIG-IRON FOR DENMARK.—Agencies wanted.—Box 734, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY

MODERN Steelfoundry at Rotherham, main building 65 ft. by 150 ft. (erected 1916); complete with 10-ton crane. Site 1 acre. Siding on L.N.E. Rly. Adjacent canal.—Apply: GORDON, P.O. Box 98, Sheffield.

MACHINERY

CUPOLA WANTED —3-4 tons per hr. with receiver. Drop-bottom type. State make, age, price, and where seen.—Box 742, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—200/250-lb. Aluminium Oil-fired Tilting Crucible Furnace. Morgan or similar. Advise lowest price to: Box 738, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY—*Continued*

WANTED.—Hand Moulding Machines, must be in sound condition; also Moulding Boxes, interchangeable. Full particulars and prices to: COOKE BROS., Ironfounders, Leicester.

WANTED.—Stationary Sandslinger Machine, complete with motors suitable 3-ph., 50 p., 400 v. Detailed description and price to: Box 744, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

½-TON MORGAN oil-fired C.A. type Tilter; 600-lb. Ditto, as new, without burners. Cheap. Also a number of NEW Crucibles, 300 lbs. and 600 lbs. capacity.—A. HAMMOND, 14, Australia Road, Slough.

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

ELECTRIC CUPOLA BLOWERS (large stock), including two 50-h.p. 3/50/400 volts, 2,900 r.p.m.; Keith Blackman; 12-in. outlet.
30-h.p. ditto; 12-in. outlet.
5-h.p. ditto; 6-in. outlet.
20-h.p. 460 volts d.c., 2,400/1,900 r.p.m.; 10-in. outlet.
EXHAUST FANS (large stock), electrical and belt driven.
ELECTRIC RUNWAY LIFTING BLOCKS:
One 4½-ton 460 volts d.c., Vaughan.
Two 2-ton ditto, Morris.
One ½-ton 220 volts d.c., Morris (as new).
One ½-ton 3/50/440 volts, Aabacas.
Two Reavell Rotary Compressors, 12 lbs. sq. in. pressure; 750 cub. ft. direct-coupled on bedplate to 60 h.p. S.R., 3/50/400 volts motor.
½-cwt. Pilkington Self-contained Pneumatic Hammer.
Geared Foundry Ladles, 9, 4, 3½, 2½ and 1 ton, etc.
AIR COMPRESSORS: 30 in stock in sizes 500 to 20 cub. ft.
ELECTRIC MOTORS: Large stock to suit almost all electric systems.
S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.
HYDRAULIC PRESSES.
80 tons cap. WILD press; 10" dia. ram; 2,240 lbs. press. per sq. in.
60 tons cap. TANGYE press; 7" dia. ram; 2' stroke; 3,360 lbs. press. per sq. in.
HOLLINGS & GUEST—50 tons cap.; 8" dia. ram; 2,240 lbs. sq. in. pressure.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MISCELLANEOUS

NEWS FOR BRASSFOUNDERS.—"Quick-Set" Furnace Cement, triple life and for repair. "Clean-RUN" Topping Flux, gives extra life for crucibles and saves fuel. Particulars from: WILLIAM OLSEN, LTD., Hull.

PATTERNS.—Cleghorn & Co. have new premises at 198-200, Bath Road, Worcester, and are in a better position to cope with all classes of engineers' pattern. 'Phone 264.

MISCELLANEOUS—*Continued*

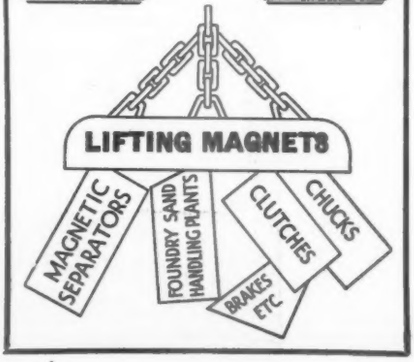
WANTED TO PURCHASE.

FOUNDRY TRADE JOURNAL. Vols. 1-12, or any parts of these. GOOD PRICES PAID.
WM. DAWSON & SONS, LTD.,
CANNON HOUSE, PILGRIM STREET,
LONDON, E.C.4.

GERMAN malleable iron foundry proprietor is prepared to accept the son of a United Kingdom foundry executive as a student for a period of six months in exchange for a similar courtesy to be extended to his. Write for particulars to: THE EDITOR, THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERNS IN WOOD AND METAL for all branches of Engineering. Moulding methods carefully considered.—FURMSTON & LAWLOR, Letchworth.

FINEST FOUNDRY BLACKINGS AND FACINGS. Pure Ceylon Plumbago (Import direct), Finest Core Gum, White Dust. Parting Powder (Silica free), Pure Ground Carbon and Electrodes. Quality at reasonable prices. Orders repeated. Send for free sample.
JOHN & C. DURRANS,
PENNINE WORKS,
HAZLEHEAD, NEAR SHEFFIELD.
Telephone: 128 Penistone. Telegrams: "Facings, Penistone."

'Phone: 287 SLOUGH
Sand Mill 4' diameter undergeared with one cogged and one plain roller, as new .....Price, £26
Tabor squeeze and pattern draw Moulding Machine for 18" square boxes .....Price, £42
Ladle by Dewhurst, 3-tons capacity. Price, £32
New Ladle with enclosed gears, 4-tons capacity .....Price, £38
New Ladle 5-tons capacity. Price, £44
Heavy double-ended Fettling Grinder.....Price, £18
Modern Jackman Sandblast Barrel Plant, complete .....Price, £70
HAVE YOU SEEN OUR LATEST LISTS?
ALEX. HAMMOND, *Foundry Machinery Merchant.*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY!

THE RAPID MAGNETTING MACHINE Co. Ltd.
MAGNET WORKS, LOMBARD ST.
BIRMINGHAM, 12
DESIGNERS & MANUFACTURERS OF